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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1882.

PUBLICATION COMMITTEE:

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1883.

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February 28, 1883.

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" 363 to 378	. . . . .	February 20, 1883.

EDWARD J. NOLAN,
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LIST OF CONTRIBUTORS.

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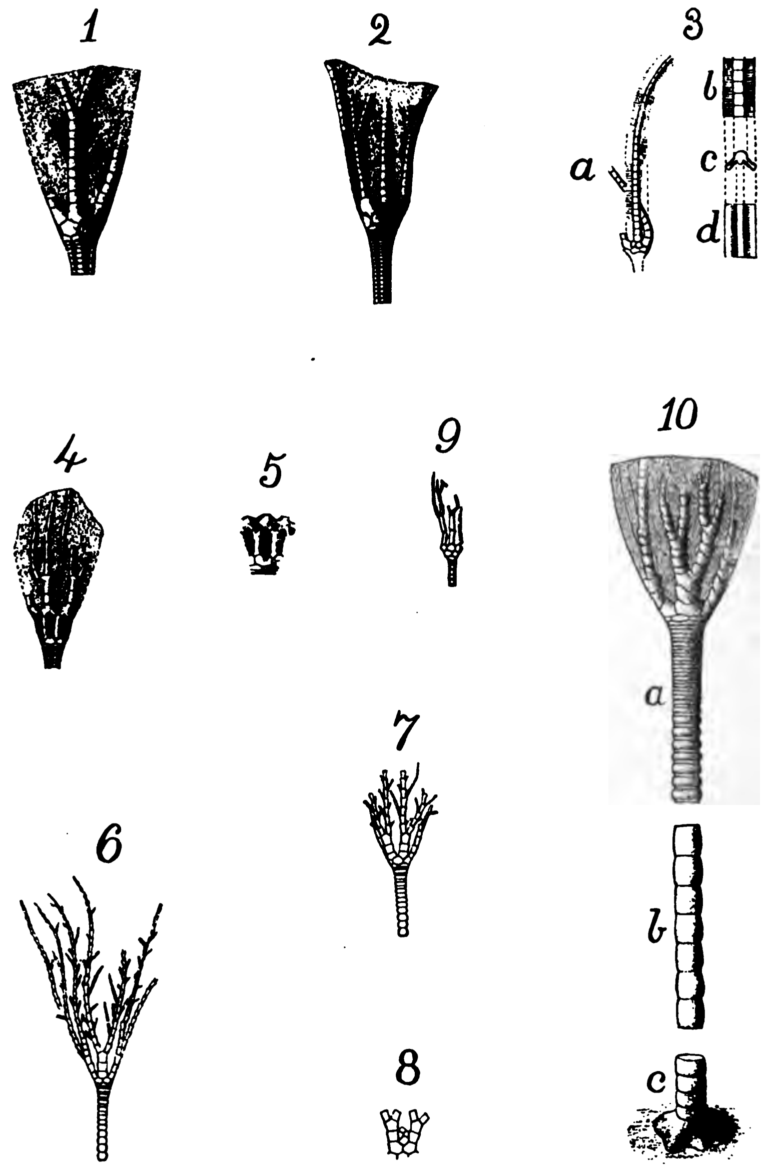
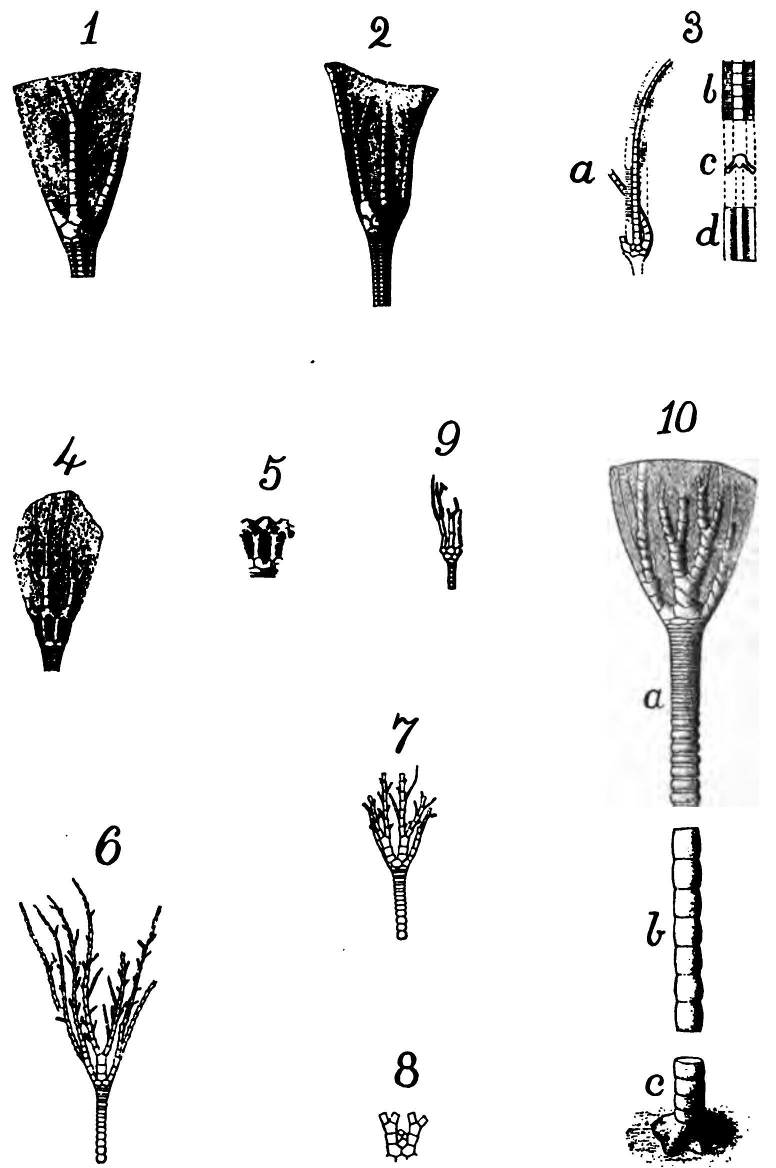


WILLIAMS ON NEW CRINOIDS.



WILLIAMS ON NEW CRINOIDS.

PROCEEDINGS

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JANUARY 3, 1882.

The President, Dr. JOS. LEIDY, in the chair.

Twenty-six persons present.

Fruiting of Ginko biloba.—Mr. THOMAS MEEHAN referred to some specimens of this plant (*Salisburia adiantifolia* of Smith and other authors subsequent to Linnæus) which had been borne by a tree on the grounds of Mr. Chas. J. Wister, of Germantown. The tree was far removed from any other flowering tree, which afforded good grounds for the belief that this specimen was hermaphrodite. In botanical classification the genus was accepted as of diœcious character. Sexual characters were, however, among the most unreliable. There would be nothing improbable in a tree bearing wholly male or wholly female flowers as a general rule, changing so far as to have both on one tree. Cases of this kind were not uncommon in *Acer dasycarpum*, and other deciduous trees, and, he believed, probable in the red cedar, *Juniperus virginiana*, an ally of the *Ginko*. In this cedar there were often trees met with which were wholly male in most seasons, but on which occasional berries might be seen; while other trees, usually so abundantly fertile as to be almost covered with blue berries, would occasionally have many more male flowers than usual. In Rubiaceous plants, where dimorphic flowers were so common—the short-styled ones and the short-stamened ones being on distinct plants, and practically diœcious—there were cases of change at times. The white-berried *Mitchella repens* which were growing on his grounds, apart from the red-berried variety, had not produced a

berry until last year, when a few were produced; and the short-styled *Bouvardia*, so common in greenhouses, and with short styles, had produced a branch on one plant under his observation the past winter, which had the styles projecting beyond the corolla. In annual plants the variation in sexual characters was well known to vary, even with external conditions. *Ambrosia artemisiæfolia*, the common rag-weed, produces mostly male flowers in poor soil, or when growing thickly together in wheat fields after the grain is cut; but when growing in the richer soil of potato or Indian-corn fields, the increase of female flowers is very marked. Sometimes plants under these conditions are found wholly female. Indian-corn also varies through some innate law. Male flowers are not uncommon on the spikes which bear the grain, while grain among the males, or "tassels," showed the occasional presence of female flowers there. It is more than likely that complete diœcism, claimed for some Asiatic coniferæ, does not really exist.

Prof. Angelo Heilprin remarked that fruit had been found on this tree recently in the Central Park, New York; and that bees might carry the pollen long distances, and fertilize female flowers. It did not follow that the presence of fruit on isolated trees involved monœcism.

Mr. Redfield observed that pollen from the large male tree, three-quarters of a century old, at the old Hamilton homestead, now Woodlands Cemetery, and but six miles away in a direct line, might be wafted by winds to Mr. Wister's tree in Germantown.

The President, Dr. Joseph Leidy, remarked that pollen from coniferous trees was known to be carried by winds to enormous distances.

Remarks on some Rock Specimens.—Prof. LEIDY remarked in relation to the rock specimens presented by him this evening, that most of them he had collected last summer on South Mountain, ten miles from Wernersville, Berks Co., Pa. The ridge consists of azoic rocks, mainly compact gneiss, often obscurely stratified and regular or not folded or contorted. With this is associated granite with little or no mica, and black syenite mostly composed of hornblende with feldspar and quartz in fine grains. The rocks in two localities of the vicinity are traversed by dykes of basaltic trap. Potsdam sandstone flanks the mountain on the eastern side, and this at the base is overlaid by the lower Silurian limestone of the Lebanon Valley. The specimens collected from exposures of the Potsdam sandstone consist of quartzite, remarkable for their sharply defined character, resembling in a manner cleavage fragments of orthoclase. The form is due to jointing, which is rhomboidal, usually in two directions crossing the planes of stratification, but also frequently parallel with the latter. Occasionally the jointing presents other

planes; thus one of the specimens, the size of an ordinary brick exhibits planes due to jointing in five different directions.

Incidentally to the foregoing, Prof. Leidy said that it would be an interesting subject of investigation to trace the source of the materials of the gravel on which our city is built. Everywhere of a red color due to the peroxidizing of the iron of the rocks from which the gravel has been derived, the basis of this latter is mainly siliceous. Many of the siliceous pebbles, from a small size to boulders approximating a ton in weight, appear to have been derived from the Potsdam sandstone, north of the city. They commonly have the same quartzite constitution; and in their irregularly rectangular and rhomboidal form, with borders and angles rounded by attrition, they exhibit the jointed condition of the Potsdam rocks. In earlier days when he learned that quartz belonged to the rhomboidal system, but exhibited no disposition to cleavage, he thought that the rhomboidal quartz pebbles of our gravel were examples showing a tendency to crystalline cleavage. Some of the quartzite pebbles, like portions of the Potsdam rocks, are of so compact a character, and banded in structure, that when polished they look like chalcedony, as exemplified by a specimen picked up on the Delaware shore.

Other pebbles of milky, smoky, and other quartz appear to have been derived from quartz veins of our neighboring gneiss rocks.

Black pebbles found in the gravel used in the construction of the bed of the junction railroad just north of the city, and collected as specimens of basanite or touchstone, appear to be hornstone or chert, like that in the lower Silurian limestone at Easton. Numerous pebbles of the same kind are found on the Delaware shore at the latter place. Limestone itself appears to form no conspicuous element of our gravels. Though abundant in the same sources of supply of the common ingredients of the gravels, its fragments have been completely dissolved away. Occasionally he had seen in the interior of a freshly broken pebble of black hornstone, such as one presented this evening, minute rhombohedrons of calcite, while on the exterior minute cavities of the same form show where similar crystals have been dissolved.

Pebbles of red sandstones and shales are frequent elements of our gravel, and have evidently been derived from the triassic rocks, so abundantly exhibited north of the city. Pebbles of compact quartz conglomerate are less frequent, and may probably have been derived from the same source. or perhaps from the coal measures farther north.

Irregular pebbles of various sizes, of a variety of granite, consisting of quartz with conspicuously large crystals of muscovite mica, occur in some localities, as in West Philadelphia, but a similar rock in place is unknown to him. The exposed sides of the mica crystals, worn into hollows of the quartz, appear so compact,

that one would hardly suspect their character without seeing the cleavage surfaces.

Fossils of any kind are extremely rare in the gravel of our immediate vicinity, and in the course of a lifetime he had picked up less than half a dozen quartzose pebbles pseudomorphic of a coral like *Favosites*, and with some obscure brachiopod impressions.

In the locality, from which the jointed specimens of quartzite of the Potsdam sandstone presented this evening were collected, he looked in vain for *Scolithus linearis*, viewed as a characteristic fossil of this formation. Some miles further off, near Sheridan Station, where an exposure of the same rock was less metamorphosed, and in part consisted of friable sand, he picked up a single specimen which contained the fossil.

JANUARY 10, 1882.

The President, Dr. LEIDY, in the chair.

Twenty-six persons present.

Three more Fresh-water Sponges.—Mr. EDW. POTTS had described in the Proceedings under date of July 26, 1881, a new species of *Carterella*, *C. latitenta;* his later identified findings during that year are here mentioned.

MEYENIA CRATERIFORMA. This sponge, first found during September, 1881, in the Brandywine, near Chadd's Ford, is of very delicate structure. Its framework of skeleton spicules is exceedingly meagre and slightly bound together, scarcely amounting to a system of meshes and polyhedral interspaces as in most other sponges; and as a consequence we find the numerous small white statospheres lying in recesses far larger than themselves, freely exposed to view from the upper or outer side of the sponge. This trait is only seen in the thinnest of encrusting sponges.

The skeleton spicules may be described as acerate, gradually sharp-pointed, sparsely and very minutely microspined. With these were mingled smaller and more slender forms, which may be an earlier stage of the same, or perhaps are dermal spicules; but beside these may be seen upon the undisturbed surface of the sponge two other forms—one, cylindrical, slender, with truncate ends—the other similar in all respects to the long birotulates which surround the statospheres. The last have most probably been misplaced from their normal position.

The birotulate spicules surrounding the statospheres, as compared with those of any other described sponges, and with the diameter of their own rotules, are relatively very long. The diameter of the completed statosphere is to that of the contained chitinous body, about as 10 to 7, and the diameter of the rotules, while per-

haps double that of the shaft, is only from one-fifth to one-seventh of their length. A number of long, sharp spines occur near each extremity of the shaft. These birotulates are disposed, as is usual, very regularly and densely upon the surface of the chitinous body; one end of each being thus supported, the other forming a second or outer coat or surface. One peculiarity, however, of their arrangement has suggested the specific name now given. In most other species the length of the foraminal tube is fixed, or approximately indicated, by the thickness of the spiculiferous coat, which closes up around and against it. In this, however, on account of the unusual length of the spicules and their necessary radial direction, a space is left about the foramen, in the centre of which the tubule appears as an elongated cone; the whole having the appearance of a volcanic crater. In mounted specimens, probably as a result of violence in making sections of the statoblasts, these spicules frequently deviate from a direct radial position and cross each other's lines in a curious manner. This sponge has also been found in the Schuylkill River and in some of its smaller branches.

HETEROMEYENIA RYDERII. This beautiful green sponge has, as yet, only been found in a branch of Cobb's Creek, a small stream whose waters reach the Delaware River below Philadelphia. It occupied the upper surface of large stones in the bed of the stream; some of the patches being four or five inches in diameter and about one-fourth of an inch thick. The surface is somewhat irregular, occasionally rising into rounded lobes. The efferent canals are deeply channeled in the upper surface of the sponge; five or six sometimes converging to a common orifice.

The skeleton spicules are stout, cylindrical, slightly curved, gradually sharp-pointed, conspicuously spined, excepting at the extremities; spines conical, sharp-pointed; when largest often curving forward or towards the adjacent ends of the spicules. As is generally the case with spined skeleton spicules, they are but slightly fasciculated; being mostly arranged in a simple series, single spicules meeting or diverging from other spicules, thus forming a delicate network, supporting the sponge flesh. With these are mingled a few, more slender, smooth spicules which may be immature, or the true dermal spicules of the sponge.

The statospheres are numerous, rather small, surrounded *first* by a series of birotulates, short, stout, the rotulæ about equal in diameter to the length of the shaft. The shafts are cylindrical or somewhat wider toward the rotules, having frequently one or more long spines near the centre. Margins of the rotulæ marked with an infinity of shallow cuts not amounting to notches.

The *second* series of birotulates, which, more than in either of the other species of this genus, marks this as a deviation from the familiar *Meyenia* type, are very different from the first. They are nearly double the length of the former, much fewer in number, rather regularly interspersed among them; the rotules are repre-

sented by six, eight or more short recurved hooks, at each end of the shaft, which is cylindrical and studded with numerous spines, equal in length to the hooked rays of the rotulæ, and curving like them from the extremities. This species is respectfully dedicated by the discoverer to his friend, Mr. John A. Ryder, in acknowledgment of much excellent advice, assistance and encouragement.

TUBELLA PENNSYLVANICA. The genus *Tubella*, as established by Mr. H. J. Carter, Feb. 1881, was represented by four species, three originally described by Dr. Bowerbank (as Spongillas), and one by Mr. Carter—all collected in the Amazon River, South America. It does not appear that any have been described from other localities. It was therefore with much pleasure and some surprise that while examining material collected at Lehigh Gap, Pa., in November last, Mr. Potts came upon undoubted specimens of the same genus. It differs from *Meyenia* in the fact that the rotulæ of the spicules surrounding the statospheres are of unequal diameters; the larger one being placed next the chitinous coat. This species, whose peculiarities do not tally with those of any of the four above mentioned, may be thus described:

Sponge minute, encrusting, thin; the skeleton spiculæ arranged in a simple series of single non-fasciculated spicules, in the interspaces of which the statospheres are abundant.

Skeleton spicules very variable in size and shape, but all entirely and coarsely spined; rounded or abruptly pointed at the extremities.

Dermal spicules absent or undetermined.

Statospheres, numerous, small; granular coating thin but extending to or somewhat beyond the outer ends of the birotulates. Length of the inequibirotulates about equal to the diameter of the larger disk, which is placed against the chitinous coat. Margin of larger disk generally entire, sub-circular; outer surface flat, table-like, the margin sometimes slightly incurved. This surface is not infrequently warped or twisted into an irregular outline. The outer disk, in the great majority of cases, is about one-fifth the diameter of the inner, but varies from, say, one-sixth to equality, which is, however, rarely observed. Its margin also appears to be generally entire, but it is undoubtedly sometimes divided into six or eight rays. The inner surface of the larger disk is also occasionally marked with rib-like rays and still more rarely the margin between the rays is wanting.

These, as before stated, are all the species whose novelty has been definitely determined; but amongst the large amount of material collected are doubtless others, belonging to the genera *Spongilla* and *Meyenia*, whose distinguishing peculiarities are less obvious, and where close study will be needed to define them.

JANUARY 17, 1882.

The President, Dr. LEIDY, in the chair.

Twenty-six persons present.

The following papers were presented for publication :

" New Crinoids from the Rocks of the Chemung Period of New York State," by Henry S. Williams, Ph. D.

" The Species of Odontomyia found in the United States," by Dr. L. T. Day.

" A New Station for Corema Conradii," by Aubrey H. Smith.

JANUARY 24, 1882.

The President, Dr. LEIDY, in the chair.

Twenty-four persons present.

The death of M. Jules Putzeys, a correspondent, was announced.

The thanks of the Academy were ordered to be forwarded to Mrs. S. J. Haldeman Haly, for the gift of a portrait in oil of the late Prof. S. S. Haldeman, by Waugh.

Notes on Monazite.—Prof. GEORGE A. KÖNIG announced the identification of *Monazite* from the mica mine at Amelia Court House, Va. It has occurred in several large masses, from fifteen to twenty pounds in weight. One in the collection of Mr. C. S. Bement exhibits two crystals, monoclinic combinations of $P\infty \,.\, \infty P \,.\, \infty P\infty$, with sides over 5 inches in length. Such gigantic masses of this rare mineral have not heretofore been reported. It occurs together with equally huge crystals of microlite, fine crystals of columbite, of manganese tantalite, amazonite, albite, apatite, smoky quartz, and beryl; of the last mineral a crystal was found, 25 inches in diameter and over 12 feet long. This monazite was supposed to be microlite or scheelite. Two varieties have been identified by the speaker; one possessing an amber or brown color (transparent finely blood-red), and giving a straw-colored powder like microlite. The other variety is gray, with honey-yellow color in thin splinters, and yields a greenish gray powder; of the former the specific gravity is 5.402 and 5.345; of the latter it is 5.138.

When finely pulverized and mixed with two to three parts of

concentrated sulphuric acid, the mineral is decomposed very quickly as soon as the temperature is brought to the boiling point of sulphuric acid. The mass becomes a dry paste and dissolves in water. The solution is turbid from a quantity of basic phosphates, varying between two and eighteen per cent., according to the excess of acid present.

The acid solution may be boiled without the forming of a precipitate; thorium is therefore not contained in the mineral. Two determinations of the phosphoric acid gave 25.82 and 26.3 per cent., one being by phosphomolybdic acid; the other in the usual manner, after precipitating the bases first by oxalic acid, and the filtrate by ammonic hydrate. Fluorine is not present.

The following is given as a preliminary result, pending the tedious separation of the oxides:

$(Ce, La, Dy, Y)_2 O_3$	= 73.82
$(Y, Fe, Ca)_2 O_3$	= 1.00
$P_2 O_5$	= 26.05
Volatile by ignition	= 0.45
	101.32

Supposing the oxides to be all cerous oxide, or in other words having the atomic weight of 92, the highest of the group, then the ratio obtains

$$P_2 O_5 : 3 \, Ce \, O = 1 : 3.75,$$

which is not reconcilable with a normal phosphate.

The speaker suggests, therefore, the possible presence in the group of a metal with a much higher atomic weight than cerium. He is engaged at work with a large enough quantity of the oxides to decide this question in time.

January 31.

The President, Dr. Leidy, in the chair.

Eighteen persons present.

Messrs. Wilson Mitchell, Chas. H. Hutchinson, Rev. W. G. Holland, Able F. Price, Alfred C. Harrison and Robt. B. Haines were elected members.

Dr. A. Baltzer, of Zurich, and Prof. Robt. Collett, of Christiania, were elected correspondents.

The following were ordered to be published:—

NEW CRINOIDS FROM THE ROCKS OF THE CHEMUNG PERIOD OF NEW YORK STATE.

BY HENRY S. WILLIAMS, PH. D.

Hitherto the rocks of the Chemung period have furnished only imperfect traces of crinoids. Joints of the stems are frequently met with, in some places in great numbers, but we find mention of only three crinoids in condition sufficiently perfect for specific identification.

Cyathocrinus ornatissimus was described by Professor Hall in 1843 (Geol. Rept. of 4th Dist. N. Y. State, p. 247), from the Portage group at Portland, shore of Lake Erie, N. Y., but the description and figures leave the generic and family relations of the species in doubt, and we find no mention of the name in the exhaustive "Revision of Palæocrinoidea," of Wachsmuth and Springer, 1879–1881.

Taxocrinus (*Forbesiocrinus*) *communis* Hall and Whitfield, is recognized in a specimen from the Chemung group at Forestville, Chautauqua Co., N. Y. (see Palæontology of Ohio, vol. ii, p. 170). The original locality for the species is the shales of the Waverly sandstone of Richfield, Summit Co., Ohio.

A third species, *Platycrinus Bedfordensis* Hall and Whitfield, is described from the upper part of the Erie shales of Ohio, which are regarded by some good authorities as equivalents of the Portage and Chemung rocks of New York. These three are the only crinoids specifically identified from rocks of the Chemung period, or their equivalents, up to the present time.

The specimens from which the following species have been determined are mostly in the condition of moulds from which the original substance of the fossil has been entirely removed, and in such cases, casts of wax or gutta percha have been used in the description of the species.

In a few cases the material is in such an imperfect condition that a proper specific diagnosis is impossible, and accordingly no specific name has been assigned, although mention is made under the generic name of such new characters as could be observed.

In other cases a large number of individuals has been found in a single locality, among which certain variations are noted, and

by comparison of all the specimens these variations are found to be pure variations and not marks of distinct species. Crinoids are generally so rare in individual specimens that it is believed that any contribution to our knowledge of the direction and extent of the variations among the individuals of a common species is of value to palæontologists.

The author expresses his thanks to Mr. Charles Wachsmuth for valuable suggestions and assistance in the identification of genera, and to Profs. John M. Clarke and S. G. Williams for the loan of specimens.

The types of the species, not otherwise designated, are from the author's collection, and will be placed on deposit in the museum of Cornell University, Ithaca, N. Y.

Poteriocrinus Cornellianus n. s. Pl. I, figs. 1, 2 and 3.

Calyx cup-shaped; arms very long; stem pentagonal and expanding at the top, under the calyx.

Underbasals small, difficult to distinguish from the final segment of the stem; junction between the several plates indistinct and in line with ridges of the stem.

Basals large, hexagonal, height and breadth subequal.

Radials large, broad, longitudinally convex, and incurving toward the vault, the edges of two adjacent radials forming a deep groove which terminates upon the upper part of the basals. The broad convex ridge, which begins on the radials, is continued in the brachials and arms up to the first bifurcation, and is in direct line with the five angular carinations of the upper part of the stem. The upper margin of the radial, straight, broader than the first brachial.

The radial is succeeded by a single series of eight (or nine) plates, of nearly uniform size, and dorsally with no lateral expansion, strongly convex, the last plate angular above, and presenting two oblique faces from which proceed two smaller arms. These arms bifurcate a second time in the course of their length. The general appearance is that these first eight plates above the radial are brachials. But, we observe, from the ventral part of the sides of each of these plates arise pinnules on alternate sides, beginning with the third or second plate of the series.

If, therefore, we regard the presence of pinnules as a mark of the arm-plates, in distinction from brachials proper, we have

here two or three brachials followed by a single series of arm-plates, six or seven in number (the number of these plates varies for the rays of a single specimen), with strong pinnules from each plate; from the last of this series branch off two subequal rays which again bifurcate.

The arms above the bifurcation are long and thickly beset with pinnules, one from each joint; occasionally a plate is intercalated without a pinnule, but the pinnules retain their alternate order.

In the middle and upper part of the arm the joints are somewhat produced on the side where the pinnules arise. Anals, three within the calyx; the lowest touches two basals, the right posterior radial and the second and third anals. The second anal lies upon the left of the first and touches the left posterior radial. The third anal is directly above the first, and touches the radial on the right, the second anal on the left, and is succeeded by a series of plates very similar (on the dorsal view) to the lower arm-plates, but with no pinnule and with straight articular faces. This is the ventral tube. This ventral tube is very long, apparently as long as the arms, but more even in size throughout.

In the typical specimen, what is preserved of this tube is one-third the length of the arms; laterally it is beset on both sides by a fringe, about the width of the plates themselves, of narrow ridges and furrows perpendicular to the axis of the tube. There are four to six of these furrows in the length of each plate, and they continue uninterruptedly the whole length of the tube. In another specimen the tube has been preserved lying mainly outside the arms, and thirty-one plates can be distinctly seen, making a tube whose length is six times the diameter of the calyx; the final plate is about half the size of the first one. A study of the specimens at command—although all but one are in the condition of moulds in fine sandstone from which the original material is entirely removed, has enabled us to make out the general external details of structure of this "tube." (Pl. I, fig. 3, *a*, *b*, *c*, *d*.)

The dorsal aspect is that of a cylinder, from a little below the centre of which extend outward and downward lamellæ which on each side are continuous; the junction at each joint of the plates is not visible, and transversely they are marked by narrow furrows. A section shows these fringe-like lamellæ to be lateral expansions of the axial plates, thickened at the outer margins and on the ventral side terminating at a narrow, medium, longitudinal

keel, which appears to be composed of two series of minute plates alternately arranged. The transverse striæ do not continue over the outer margin to the ventral side, but reappear in the furrow at the base of the ventral keel.

This is all that can be determined from the specimens, which show only the outside cast of the tube. Whether the transverse striæ are marks of external furrows, or of narrow perforations, or whether this be the whole of the tube, which was hollow, or an axis upon which softer tissues were engaged, are indeterminate from these specimens.

Dimensions.—Stem, diam. at top, 3.0 mm., below, 2.8 mm.; calyx, diam., 7.0 mm.; arm at base, diam., 2.0 mm.; primary radial series, length, 5.1 mm.; arms, length, 45.0 mm.; arms, first five joints at base, 6.–6.6 mm.

Locality.—Ithaca, N. Y.

Horizon.—Chemung group, 200 ft. above base.

One of the finest specimens of this species was collected by Mr. A. H. Cowles (C. U., '82), of Cleveland, Ohio, and presented to the author. It is taken as the type of the species.

The species is not uncommon, in the condition of stems and fragments, in Cornell University quarry, and in the same stratum at other outcrops, but the heads or even arms are very rare.

[1] **Poteriocrinus** *sp. prima*).

Two nearly perfect arms were found by the author on a fragment of rock, from cliffs of the upper Portage, which differ from any species known, but are not enough for specific diagnosis. The size and general appearance are those of *Poteriocrinus Cornellianus*, but it differs in the arrangement of pinnules, which appear regularly on each side from every fourth joint.

The pinnules are shorter and more slender than those of *P. Cornellianus.*

Locality.—Ithaca, N. Y.

Horizon.—Portage group (?); from slab not in place but probably from this formation, or just above.

To avoid the necessity of establishing new specific, or varietal names upon inadequate evidence, use is made of the denominations *species prima*, *sp. secunda*, etc., under the appropriate genus, and *varietas alpha*, *var. beta*, etc., under the appropriate species as a means of designating new facts, whose taxonomic relationship cannot be satisfactorily determined from the material at command.

Poteriocrinus Clarkei n. s. Pl. I, fig. 4.

Calyx obconical, small, gradually expanding from the top of stem, which also gradually expands and the calyx contin 's evenly the rate of increase in size begun in the stem.

The radials are very convex in the centre, making a conspicuous enlargement at this point.

Underbasals of medium size, pentagonal, as high as wide.

Basals large, hexagonal, higher than wide, and twice the height of the underbasals. Radials of medium size, truncate above, irregularly pentagonal, smaller than the basals, wider than high, externally quite gibbous.

Brachials, two for each ray.

The first brachial short, cylindrical, with a straight margin above and below, height and width equal, much narrower than the radial; second brachial cylindrical, and at the base the same size as the first brachial, but near the top it suddenly expands to nearly double width, angular above, bearing two arms which do not bifurcate. In one specimen one of the second brachials bears three arms each of equal and normal size.

The joints between the primary radial plates gap, as do also, in some specimens, those of the arm-plates.

The brachials are free, parallel, and separated by a space as great as their diameter.

The surface of the calyx is marked by two rows of depressions; the first is elongate, longitudinally, its bottom lies along the suture between contiguous basals, takes in the point of the underbasal and the lower part of the radial; near the top of this groove is a horizontal ridge not reaching the general surface, but uniting the two walls of the groove, and it is more prominent in some specimens than in others.

In the second row, the depressions are smaller, triangular, pointed below, and have their centres over the angle of meeting of the basal and two approximate radials; each cavity extends upon the edges of each of these three plates.

Stem, above pentagonal with thin disks, below gradually becomes cylindrical, and the disks elongate till their length equals half the diameter, are not convex but form a smooth cylindrical stem; from this part cirri are frequent, standing at right-angles to the stem.

Anals not known.

This species resembles *Pot.* (*Scaphiocrinus*) *Whitei* Hall, '61,

p. 306, but differs in the longer body, column more rapidly expanding at the top, larger calyx, the basals being larger in proportion, and in the presence of two brachials instead of one; also, the arms do not branch, so far as determined from the specimens, and the plates are not conspicuously prominent at the offset of the pinnules. The surface markings are much alike in the two species, but there are several other species similarly marked.

Dimensions.—Calyx, height, *a* 4.5 mm., *b* 4.4 mm.; width, *a* 5.1 mm. *b* 5 mm.; stem, diam. at base of calyx, *a* 2.4 mm., *b* 2.4 mm.; diam. lower down, *a* 1.4. mm.; primary radial series, height, *a* 5.2 mm., *b* 4.1 mm.; first brachial, diam. *a* 1.3 mm., *b* 1.2 mm.; first arm-plate, diam., *a* 1.1 mm., *b* 0.9 mm.; first five arm-plates, length, *a* 7.9 mm.

Locality.—Haskinsville, Steuben Co., N. Y.

Horizon.—Chemung group.

Collected by, and named for, Prof. J. M. Clarke, of Smith College, Northampton, Mass.

Poteriocrinus Clarkei, var. alpha n. v. Pl. I, fig. 5.

This variety is based upon the impression of part of a calyx found by the author at Ithaca, N. Y., in the lower part of the Chemung group.

It is about twice as large as the Haskinsville specimens, and the pittings of the surface are more strongly marked. The cross-bar in the upper part of the long grooves is particularly strong in comparison, but in shape and proportion of plates, the differences are so slight that we provisionally regard this as a variety of *P. Clarkei.*

Locality.—Ithaca, N. Y.

Horizon.—Chemung group, lower part.

Poteriocrinus (Decadocrinus) gregarius n. s. Pl. I, figs. 6, 7, 8.

Underbasals minute.

Basals hexagonal, twice the size of the underbasals, as wide as high, the angles not sharply defined.

Radials about same height as basals, but broader and pentagonal, with the upper margin only slightly concave.

First brachial four-sided, longer than broad, and expanding toward the top, the upper margin conspicuously concave; base, same width as upper edges of radial.

Second brachial pentagonal, base convex and narrow, breadth

increasing to the top, where the width is equal to the total height of the plate, the two upper edges standing obliquely at about a right-angle, and subconcave.

Surface of calyx and arm-plates smooth and gently convex.

The rapid enlargement of the consecutive series of plates up to the brachials forms a low, expanded cup. The first plates of the arm are a third smaller than the terminal part of the stem just under the calyx.

The arms are long, ten in number, and do not branch; each arm-plate bears a pinnule. Pinnules are arranged alternately on each side of the stem, and occasionally a plate appears without pinnule, but the alternate order of the pinnules is not broken. The first five or six arm-plates are cylindrical, about the length of the last brachial, and, dorsally, show little extension, either laterally, or longitudinally at the point where the pinnules are attached, but after the fifth, the side from which the pinnule starts is slightly higher and extends laterally more than the other. The centre of length of the arm of the fully developed individual is at the tenth or twelfth plate, and here the plates are a third longer than their average diameter, and the pinnules are strong, gradually tapering to a point and composed of ten or twelve plates (or six to eight in the shorter pinnules); the first one is about half the size of the base of the arm-plate, from which it springs.

The arms are spreading, and an occasional specimen is found spread out radiately upon the surface of the slab.

The anals, and succeeding plates of the ventral tube, are not apparent on all specimens, but from examination of all the material at hand, we conclude that the arrangement of the proximal plates of the series is that normal to the genus *Poteriocrinus*, as defined by Wachsmuth and Springer, but the origin is frequently higher up in the calyx. In several specimens the anals do not reach the basals, but begin on the slopes of the two adjoining radials, which meet under them; but one specimen, which appears very well preserved, without distortion, has the normal arrangement of anals, three plates being in contact with calyx plates; the lowest lies a little to the right, between the adjacent, upper, sloping edges of two basals; above these anals can be distinctly seen, three or four plates in each of the two series of the ventral tube. The irregular position of the anals among the calyx plates possibly may be accounted for by distortion of the

specimen by pressure, but this is not self-evident, but inferred to explain what appears to be abnormal. Attention is drawn to the fact to show that species or genera established upon single or few imperfect specimens are not always to be relied on.

The stem is composed of discoid segments, externally convex and serrate at their union; arranged in two sets, one thinner than the other, in alternate order. The difference is greatest near the base of the calyx, where also the plates are thinnest; the thickness (or length) of the individual joints increases with distance from the calyx; the size of the stem slightly diminishes, and the difference between the two sets becomes obliterated, until the joints reach a length equal to their diameter, and the serrate union is inconspicuous, the outer surfaces becoming very convex. This latter is the common character of the central part of the stems, the joints being subglobular and of uniform size. Slender cirri proceed from all along the stem; they have been observed within an inch of the calyx, and are generally found rather closely coiled at their ends.

The upper part of the stem appears slightly pentagonal, but the angles are rounded and within an inch of the base of the calyx all trace of them is lost.

Dimensions of type specimen—which are a little greater than for the average of the specimens examined: Stem, diameter, 1.3 mm.; calyx, width, 2.3 mm.; arms and body together, total length, 21.6 mm.; primary radial series, height, 3–3.3 mm.; second brachial, width, greatest, 1.4 mm., average, 1.2 mm.; first five arm-plates, length, 4.1 mm.; second five arm-plates, length, 5.1 mm.

Locality.—Ithaca, N. Y.

Horizon.—Chemung group, 130 feet above base.

Three varieties are noted among the numerous specimens and fragments taken from the same stratum with the type specimen.

Var. *alpha* is distinguished by its smaller size, and the arms shorter, and composed of fewer, more slender plates.

Those characters of the stem, peculiar to the terminal portion, just under the calyx, are seen for only a very short distance.

The calyx and its plates do not differ, to any appreciable degree, from those of the specific type, in number, arrangement, relative size or shape.

Var. *beta.* The calyx is large, the plates well developed, the stem as large as in the typical form, and up to the base of the

arms this variety appears identical with the type of the species, but the arms are exceedingly short—not more than six plates appearing in the longest arm preserved.

One of the arms begins with two full-size plates, starting out, and in shape, like the typical form, but these plates are followed by three very slender plates, the base of the first not filling completely the facet at the top of the preceding one. The arm adjoining it has one normal-sized plate, followed by four slender plates. The other arms, as far as they can be examined, show a like arrangement, and the explanation is unavoidable, that the original arms were broken off, and were being replaced by new arms not fully developed when growth and life were stopped and the hard parts buried, and thus preserved to tell the story.

Var. *gamma.* A third variety is worth mentioning. In general characters it corresponds with var. *alpha*, but differs conspicuously in the plates of the ventral tube. At the base the anals are arranged as in the normal specimen, while the upper part appears to have special development.

There appears on the right side of the normal series of anal plates, beginning about half way up, a third series of plates about the same size as those at the corresponding height in the other series. The series, beginning lowest down, thus becomes the central one at the top, and eight plates can be counted in it. The lateral series have fewer plates, and the upper part loses itself in minute granulations at the base of the arms.

This species, of which many specimens were taken from a small locality, shows considerable variation in the length of the arms, in the number, relative size and shape of the arm-joints, in the character of the stem-joints at the base of the calyx and a short distance below until the normal characters of the stem are reached, and in the number and arrangement of the more distal part of the plates following the anals.

In these several respects the specimens under examination present hardly two which are uniform, and single specimens show more or less variation in the several rays.

There is also considerable difference among the specimens in the relative shape of the calyx and in the general arrangement of the arms, which is explained mainly by different degrees of, and direction in, compression since the specimens were buried.

The difference in the arms and arm-joints, we are led to believe,

is the effect of difference of age of the specimens. Thus, we observe, in this species, that the smaller specimens have less expansion of the stem at the top, the thin disk-like stem-joints are limited to a shorter distance downward from the calyx; the arms are shorter, the arm-plates fewer, and more slender, and apparently more uniform in size and shape than in larger specimens. In larger specimens, with the more fully developed arms, we observe the plates at the base are strong, length about equal to width; in the middle portion of the arm, they are more slender and only slightly diminished in diameter; in the upper part, the plates are of a medium length, but are strongly developed on the side from which the pinnule starts, and the stem becomes more or less zigzag in shape; with all these differences, the articular faces between the arm-plates show only very slight tendency to become oblique, a character so conspicuous in other species of the genus.

The pinnules normally start from every joint first on one side, then on the other, but frequently variation is seen in this respect, by the interposition of a plate without pinnule; in some cases this occurs frequently on a single arm, giving the appearance of pinnules from every other plate. In no case is the alternate order of the pinnules disturbed by this variation.

The differences in the plates succeeding the anals appear to be purely varietal, and associated with no concomitant variation in other parts, and may be due, in a measure, to differences in state of preservation.

The normal arrangement of anals is that of *Poteriocrinus*, as given by Wachsmuth and Springer, "Palæocrinoidea," '79, p. 110, but if we regard the calyx as stopping with the top of the radial we should have several cases where the anals are entirely above the calyx, as the lowest anal lies in the angle formed by the upper oblique faces of two adjacent radials. This accounts also for a narrower calyx.

Another specimen has but a single series of anals, resting upon the upper, sloping margins of the adjoining radials, thus reminding us of *Heterocrinus*. Still a third (see var. *gamma*) starts with two series of plates at the base, which appear to reach the basal series, and opposite the first brachial, a third series starts in on the side. Other specimens show the normal *Poteriocrinus* arrangement of anals, the first plate resting between the upper

angles of two basals, followed by two plates touching the adjacent radial, as explained above.

This species offers points of resemblance to several species of the genus, but it appears to be distinct, even allowing the great variation. As one feature after another is examined in the different specimens, such species as the Ohio *Scaphiocrinus subtortuosus* of Hall, the Burlington, *Scaphiocrinus fiscellus*, Meek and Worthen, and several others are recalled; but the species, taken as a whole, in its general features as well as in the details, appears most nearly related to *Poteriocrinus diffusus*, Hall, '62, 121, and *Pot.* ("*Scaphiocrinus*") *œgina*, H., '64, 57—the former from the Hamilton group of New York and the latter from the Waverly group of Ohio.

Prof. Hall has noted the resemblance of the two to each other; one point of difference is in the arm-plates. In the Hamilton species every second or third plate bears a pinnule, and "the intermediate joints are shorter than those bearing armlets."

The Waverly species bears pinnules from each plate.

The species under consideration shows considerable variation in this respect even on a single specimen. The writer has not had access to the types of the two species above referred to, but from study of the figures and descriptions, together with the fine series of specimens of *P. gregarius*, it would not seem unreasonable to expect that specimens may eventually be found uniting all three species into one.

Poteriocrinus (Decadocrinus) Zethus n. s. Pl. I, fig. 9.

Body turbinate, with two long, slender brachials to each ray. These long brachials, with the arms, form a narrow elongate head with subparallel sides.

Underbasals minute, height and width about equal. Basals ("subradials" of Hall), a little higher than wide, rounded hexagonal. Radials wider than high, rounded pentagonal, the upper edge nearly straight, but falling off a little at the corners, beyond the base of the first brachial, which is narrower than the greatest width of the radial.

Brachials, two for each ray, subequal in length, cylindrical, twice as long as wide, length of each about that of height of calyx; the second brachial expanded at the top with inclined faces for attachment of first arm-plates.

Arms short, slender, the plates few and fully twice as long as wide.

The arm bears a pinnule at the third joint; (or bifurcates at this point, the specimen is too imperfect to determine which).

Anals unknown.

Column rounded, relatively strong, not expanding under the calyx, composed of two kinds of joints, alternating regularly, from above, first a thin, then a subglobular joint, and not varying in size or proportion for the length of stem exposed.

Dimensions.—Diam. stem, 0.8 mm.; calyx, width, 2.2 mm.; calyx, height, 1.5 mm.; primary radial series, length, 3.5 mm.; second brachial, mean width, 0.7 mm.; first arm-plate, length 1.0, width, 0.3.

This species resembles *P. Nycteus*, Hall, '61, 120, but the brachials and arms are stronger, and the brachials longer in proportion to the calyx. The resemblance suggests the name for the species, *Zethus*, who was the grandson of *Nycteus.*

Locality.—Ithaca, N. Y.

Horizon.—? Portage group, from a loose slab near the the top of the Portage, and supposed to have fallen from the rocks just above where found.

In collection of Prof. S. G. Williams, Cornell University.

Taxocrinus Ithacensis n. s. Pl. I, fig. 10.

Body expanding moderately; calyx shallow, broad; arms strong, of medium length, the whole head rather slender for the genus.

Underbasals minute but appearing as a thin, irregular band above the last stem segment.

Basals small, low, subpentagonal.

Plates of the first radial series, strong, large, well developed.

Radials pentagonal, upper edge deeply sulcate, broader than high; articulation with first brachial narrower than the full width of plate; surface broadly convex.

Brachials, two for each ray. First brachial subquadrate, width and height about equal, wider at top than at bottom, upper margin broadly sulcate.

Second brachial, the largest plate of the body, expanding above, subpentagonal, upper margin angular.

Primary arm-plates, four (or rarely five) strong, about half the size of brachials; the arms branch twice (or three ? times); each branch of four or five plates.

Arm-plates convex, but not angular, about as high as wide; no

pinnules seen; each arm-plate deeply sulcate on its upper edge for articulation with the following plate, the upper angle produced ventrally so as to appear subauriculate on a side view.

Stem strong, round; the joints under the calyx thin and crenulate at margins; the thickness increases gradually for half an inch downwards, then there appear two sets, one thick, one thin; the thick plates increase in thickness and become strongly convex; the thin disks finally appear to drop out, and the main part of the stem consists of long nearly cylindrical joints, only slightly convex, and united by finely serrate margins. The root is a simple, low, conical expansion of the end of the stem, and is found attached to the shell of *Spirifer lævis*, in several cases.

Dimensions.—Stem (just below calyx), diam., 2.9 mm.; width of calyx, 5. mm.; primary radial series, height, 4. mm.; second brachial, width, 2.8 mm.; first four arm-plates, length, 4. mm.; total length of body and arms, 20. mm.

Locality.—Ithaca, N. Y.

Horizon.—Portage group, *Spirifer lævis* beds.

Taxocrinus Ithacensis. var. alpha n v.

This variety is about half the size of the typical form of the species occurring three or four hundred feet below.

The arms are shorter, and attain only the second bifurcation.

The stem, at the top, has but a few of the uniformly thin disks, the alternate sizes beginning to appear much nearer the base of the calyx (within a quarter inch) than in the typical form. Otherwise, the calyx—the shape and number of plates in the calyx and in the primary radials—the first series of arm-joints, four (rarely five)—the second series, four or five—their convexity, and all other characters observed (except the smaller, and slightly shorter, stunted form), are precisely as in the type specimens of the species.

In some specimens of this variety, one of the arms is observed to have but two primary radials, the other rays have three. This I can look upon only as a varietal character, as in the secondary series we generally see variation in each specimen from four to six joints.

Locality.—Ithaca, N. Y.

Horizon.—Chemung group, about three hundred feet above the *Spirifer lævis* beds of the Portage group.

Taxocrinus curtus n. s.

In general appearance this species resembles variety *alpha* of *T. Ithacensis*, but is still shorter, and the calyx is very low and widely expanded.

The underbasals do not appear on the surface.

The plates of the primary radial series are striate, or subcarinate along the centre, with faint parallel striations each side, and the surface indistinctly granular; total length of the three is once and a quarter the width of the second brachial.

Basals relatively smaller, about the height of the radial.

Radial very short, broad, sublunate.

First brachial subquadrate, height less than the width, which is less than the width of the radial.

The second brachial is the largest plate of the body, wide, pentagonal, with two broad, oblique edges for attachment of arms.

The arm-plates are less deeply sulcate at the upper margin than in *T. Ithacensis* or in the variety *alpha*.

Primary arm-plates, four, or three, convex, subcarinate. The central striæ, or carinations, are continuous from the brachials to the end of the rays, diverging at each axillary plate. The stem is composed of two sets of joints, the one thick, the other thin, from the base downward and it does not expand at the top as in *T. Ithacensis*. The very thin plates with crenulate edges, occurring under the calyx in that species, are wanting, as are also the extra large joints occasionally appearing along the upper part of the stem.

At first sight the types of this species appeared like extreme varieties of *T. Ithacensis*, in the line of var. *alpha*, but upon close comparison it is observed that not only are the arms shorter and of fewer joints, but the whole body is more stunted, and the primary radials, as a whole, and the individual plates composing them are proportionately shorter and wider than in that species, and the striation of the plates is not observed in any of the specimens referred to *T. Ithacensis*.

As fossils are defined, this is doubtless a distinct species, but it would not be surprising if a larger series of specimens should reveal the fact that the characters upon which it is founded are of no more than varietal value.

Locality.—Ithaca, N. Y.

Horizon.—Portage group, *Spirifer lævis* beds.

Melocrinus Clarkei n. s.

The shape of the calyx cannot be determined on account of the crushed condition of the specimens, but the shape and number of the plates agree so well with those of *M. Bainbridgensis*, H. and W., that it is probable that the shape was the same, *i. e.*. broadly turbinate. In size, also, the calyx agrees well with that species.

No underbasals appear.

The basals are low, wide and pentagonal.

The radials are more than double the size of the basals, height and width equal, or wider than high. The variation in the shape of this plate, in the several specimens upon the one slab, covers the extremes met with in the two species *M. Bainbridgensis* and *M. breviradiatus*.

The radial is followed by two brachials of smaller size, the first hexagonal, the second pentagonal and angular above, and each is about equal in height and width.

The second brachial supports two arm-plates (still within the calyx), nearly as large as the brachials, irregularly pentagonal and meeting at their inner edges.

Of the secondary radials, three are within the calyx, the second is about half as high as wide, the third is very short. The third pair of secondary radials together bear a strong arm, gradually tapering to a point, about three times the length of the calyx. It is broad, flattened on the back and longitudinally depressed along the centre, and is composed of a double series of very short plates, meeting at the centre and arranged in opposite (not alternate) order.

On the outer and ventral side the arm bears long, slender, cord-like branchlets, which appear to have fine thread-like appendages along their sides. In the central part of the arm these branchlets are as long as the arm itself. They proceed from every third arm-plate, instead of every fourth, as in *M. Bainbridgensis*, and the plates from which they appear are opposite each other, and their outer sides are lengthened slightly.

The interradials are apparently like those of *M. Bainbridgensis*, beginning with a large plate between the upper parts of two adjacent radials, followed above by two smaller plates, and these by more still smaller plates, the number or arrangement of which is not uniform.

The calyx-plates are marked by granulations over the central

portion, are rounded at the margins, which in some cases are elevated slightly above the central part of the plate, causing a depression, as in *M. Bainbridgensis;* other plates (even on the same specimen) are convex, as in *M. breviradiatus.* The rows of fine ridges, connecting the calyx-plates at their juncture, are very distinct in some cases, and do not appear in others. The former is a character of *M. breviradiatus.*

The stems are composed of alternately thin and thick plates, the relative order, or proportions of which, are not constant, even varying on the same stem when preserved for long distance.

This species is closely related to *Melocrinus Bainbridgensis*, Hall and Whitfield, 1875, from the Huron shale, Bainbridge, Ohio, and to *M. breviradiatus*, Hall (figured on a plate of "New Crinoidea, Pl. 1," which was published, with explanation of plates, in 1872), from the Hamilton group.

The study of the specimens (all on a single slab), from which the above diagnosis is made out, has revealed the fact that apparently all the characters distinguishing the two species just named are variable in those specimens. The arms must be excepted; none are known for *M. breviradiatus*, and those described for *M. Bainbridgensis* were not found attached to any calyx.

While, therefore, we retain a distinct specific name for the specimens under consideration, we are led to believe that examination of a larger series of specimens may make it necessary to unite these three species in one.

Locality.—Ontario County, N. Y.

Horizon.—Genesee slate (? Portage group).[1]

This species was discovered several years ago, and by Prof. N. T. Clarke, of Canandaigua, N. Y., was brought to the notice of Prof. James Hall, who gave it the name "*Ctenocrinus Clarkei,*" in honor of Prof. Clarke. But as no description or figure was made of the species we publish it as new under the specific name proposed by Prof. Hall.

Among the material collected by Prof. John M. Clarke from

[1] [The specimen above described belongs to the fauna of the Hamilton (not Chemung) period.

A second specimen, which I have not seen, came from Portage rocks; and this second specimen, Prof. J. M. Clarke informs me, is apparently the same species but has never been scientifically identified.] —H. S. W.

the Chemung rocks at Haskinsville, Steuben Co., N. Y., are two species of *Poteriocrinus*, belonging to the type of *P. Cornellianus*, but evidently distinct. The specimens are so imperfect that a satisfactory specific diagnosis cannot be made out, but we will record the characters which can be distinguished.

Poteriocrinus (*sp. secunda*).

Stem at the top strongly pentagonal, carinate and expanding.

Calyx small, rapidly expanding. Arms large, and arm-plates convex.

Underbasals small, low, broad, arched above, subpentagonal.

Basals a little higher than underbasals, and twice as wide as high.

Radial twice as large as basal, broad, sublunate, with the points turned upwards.

Primary radials very large, nearly as wide as the calyx below the radials, composed of short plates with straight sutures and of at least seven plates; the specimen is imperfect just before the bifurcation.

There are small, deep pits in the calyx at the lateral and upper angles of the basal-plates as if their corners had been abruptly bent in toward the centre. The upper part of the stem and the numerous primary radials are features resembling *P. Cornellianus;* but the specimen is fully twice as large; the calyx is much smaller and expands more rapidly, and the pittings of the calyx are peculiar.

Poteriocrinus (*sp. tertia*).

Stem roundish, subpentagonal near the top, with cirri standing out obliquely and straight from the stem, of which several appear within an inch below the base of the calyx.

Calyx low, small.

Underbasals cannot be distinguished, but evidently present and small.

Basals about as high as wide and nearly as large as the radials.

Anals unknown.

Radials subpentagonal; the insertion of the first brachial occupies the full width of the plate. There are six plates in the primary radial series; pinnules appear from the plates above the third. The sixth primary radial (the fifth brachial) is angular

above and from it the ray bifurcates. On each side pinnules start from every alternate plate.

Pinnules short.

This resembles *Pot. Cornellianus*, but it is considerably larger, the stem is less strongly pentagonal at the top, and the primary radials are six, instead of eight or nine, as in that species.

The specimen is on a slab with *Dictyophyton*.

Locality.—Haskinsville, Steuben Co., N. Y.

Horizon.—Chemung group.

EXPLANATION OF PLATE I.

PAGE.

Figs. 1, 2 and 3. POTERIOCRINUS CORNELLIANUS 18

1. Anterior view; showing calyx and lower part of arms.
2. Anal view; showing anal plates and ventral tube.

3 *a*. Another specimen; showing long ventral tube, a part of the calyx and one of the arms running under the ventral tube.

3 *b*. Section of ventral tube, dorsal view enlarged.

3 *c*. View of transverse section of the ventral tube.

3 *d*. Ventral view of same; showing the short furrows or lamellæ extending from the ventral longitudinal axis only part way toward the edge of the lateral fringe-plates.

Fig. 4. POTERIOCRINUS CLARKEI 21

The *three* arms proceeding from one of the distal brachial plates is exceptional; generally only two are seen for each ray.

Fig. 5. POTERIOCRINUS CLARKEI var. ALPHA 22

Figs. 6, 7 and 8. POTERIOCRINUS GREGARIUS 22

Fig. 9. POTERIOCRINUS ZETHUS 27

Fig. 10. TAXOCRINUS ITHACENSIS 29

a. Head and upper part of stem. *b*. A few joints from the central portion of the stem. This is the general character of the fragments of stems. *c*. Base of the stem, with the disk by which it is attached; in this case to the surface of a *Spirifer lævis*.

Figs. 1, 6, 7 and 10 are enlarged about once and one-half, and figs. 3 *b*, *c*, *d* and 8 are twice natural size.

A NEW STATION FOR COREMA CONRADII, TORR

BY AUBREY H. SMITH.

This rare plant was formerly collected in the Pine Barrens of New Jersey, by Torrey and Knieskern. It is now lost from the places indicated by them, though diligent search has been made for it there by Messrs. Redfield and Parker.

It was at one time found on Long Island, but not of late years. It is probably extinct both in New Jersey and on Long Island.

It has been found on Cape Cod and on the Kennebec, New Bath, Maine, and in Newfoundland. Whether it is now to be found in these places or not I am not informed.

The specimens which I exhibit to-night were collected in the Palmaghatt Glen or Pass of the Swawangunk Mountains, by Mr. Edward A. Smiley, at my request, in October of the present year. His father, A. H. Smiley, the proprietor of the Minnewaska House, informed me in the preceding month of August, that there was a singular little plant, with the aspect of a very small cedar, growing on a ledge of rocks on the Palmaghatt, some two and a-half miles from his house.

From the rather inaccurate description of it given me by him and his son, whose intelligent curiosity had also been directed to the plant, I surmised that it might be *Corema*.

I therefore engaged Mr. Smiley at the first opportunity to collect, and send me by mail, specimens of it.

It grows, Mr. E. A. Smiley writes me, on the edge of a precipice of upper silurian rocks of Ulster County, in a very thin soil. In May next I hope to have from him specimens in flower and fruit.

The plant appears to be one of those which are verging to extinction, the conditions of its environment seeming to be against its prolonged life,

PROCEEDINGS
OF THE
MINERALOGICAL AND GEOLOGICAL SECTION OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

1880–1881.

JANUARY 26, 1880.

Some New Pennsylvania Mineral Localities.—Mr. CHAS. M. WHEATLEY reported, through Mr. Lewis, the following localities not mentioned in Dr. Genth's Report on the Mineralogy of Pennsylvania: Jones Mine, Berks Co., Pa.; Aurichalcite, Melaconite, Byssolite. Upper Salford Mine, Montgomery Co.; Azurite.

Pseudomorphs of Serpentine after Dolomite.—Mr. H. CARVILL LEWIS drew attention to some specimens of associated serpentine and dolomite which he had found within the city limits, and which appeared to be pseudomorphs. He had found them in the Twenty-second Ward, on Paul's Mill Road, near the Wissahickon Creek. A range of serpentine and steatite here crosses the creek, being the same which crosses the Schuylkill at Lafayette and continues through Montgomery County in a southwestwardly direction. It here appears to conform closely, both as to strike and dip, with the adjoining gneiss, whatever its origin. All along its northern edge the steatite is filled with hard nodules of dark serpentine, which Mr. T. D. Rand has shown to be pseudomorphous after staurolite.[1]

At the locality mentioned, this peculiar rock contains veins or lenticular beds of massive, cleavable dolomite. This dolomite is frequently traversed in the three directions of its cleavage-planes by thin seams of serpentine, while irregular masses of steatite or serpentine also run through it or protrude into it from without. When the interpenetrating serpentine is in a thin seam it may frequently be observed to assume a pseudomorphic character. It may assume the shape and external characters of dolomite, while retaining the color and composition of serpentine. It then possesses both the rhombic cleavage-planes and the jointed structure of the dolomite, and often, also, its characteristic transverse striæ. In some of the specimens collected the serpentine presents a step-like appearance, and when it coats successively

[1] Proc. Acad. Nat. Sciences, 1871, p. 308.

alternate blocks of dolomite, rising one above the other, it might be compared to a flight of tiny white marble steps, covered by a green carpet.

At times, whole blocks of dolomite are replaced by serpentine. Transverse striæ have been noticed only on very thin seams, yet here they are quite as distinct as upon the adjacent dolomite. Rhombic cleavage-planes, however, are very common throughout the serpentine, although, unlike the dolomite, these markings are generally only superficial. In very exceptional cases the eminent rhombohedral cleavage of the dolomite is retained by the serpentine. While the serpentine has thus acquired the external form of dolomite, it possesses its identity as serpentine. When broken it shows the irregular or conchoidal fracture characteristic of true serpentine. When a fragment is immersed in warm acid, a momentary effervescence often takes place, owing to the adherence of thin scales of dolomite, as proven by the microscope.

No actual passage of dolomite into serpentine has been observed on the specimens collected. The two minerals are distinct. The line of demarkation between them is always sharp; pure serpentine lying in juxtaposition with pure dolomite. The dolomite is the white, glassy, cleavable variety, containing about one and one-half per cent. of carbonate of iron, as determined by volumetric analysis.

From the description which Professor Dana has given of the serpentine pseudomorphs found at the Tilly-Foster iron-mine,[1] it appears that in several particulars those of the Wissahickon are quite similar.

In the use of the term *pseudomorph*, it must not be understood that it implies an actual alteration. The specimens here described may be classed as *pseudomorphs by substitution.* It appears that the dolomite has not been altered into serpentine, but has been replaced by it. As is probably the case with all pseudomorphs by substitution, the original material is more soluble than that which is substituted. Whole rhombs of dolomite appear to have been dissolved and simultaneously replaced by the deposition of serpentine.

That this is a case of pseudomorphism by infiltration and replacement, is indicated by the fact that in one specimen a rhomb of dolomite is replaced by magnetic chromite. The chromite occupies the full width of the narrow seam of serpentine for a short distance, and was evidently deposited from the same solution which held the serpentine.

In discussing the origin of these and similar pseudomorphs, it is important to bear in mind the fact of the sharp juxtaposition of the two substances, and the consequent possibility of their having been formed contemporaneously. It must also be remembered that the dolomite, which contains the pseudomorphs of serpentine,

[1] Amer. Jour. Science, vol. viii, 1874, p. 371.

lies itself in a bed of serpentine, and that it is therefore possible that the pseudomorphs were formed at the very time of the original crystallization of the dolomite. If we grant that the dolomite, and the bed of serpentine which contains it, were formed simultaneously, it may readily follow that the minute pseudomorphous seams of serpentine *within* this dolomite were enclosed during the very act of crystallization of the dolomite. With this view, we might regard these pseudomorphs by substitution as having been deposited, not by an infiltrating solution from without, but by a solution which was being *expelled* from the interior of the dolomite by the crystallizing power of the latter. If such were the case, the serpentine would readily assume the *habitus* of the dolomite, and the same crystallizing force which caused the cleavage-planes and the transverse striæ upon the dolomite would superinduce them upon the enclosed serpentine.

Contemporaneous pseudomorphism implies a pseudomorphism by association. True pseudomorphism by substitution, like epigenesis, is subsequent. While not attempting in the present case to determine the relative time and, therefore, the kind of pseudomorphism, the foregoing remarks are offered merely as suggestions in reference to a subject already so fully discussed by eminent writers.

New Localities for Barite.—Mr. Lewis contributed the following new Pennsylvania localities for barite:

1. Bridgeport, Bedford Co. It occurs here in small tabular crystals in red Catskill sandstone (No. IX).

2. Broad Top Mountain, Huntington Co. Thin transparent coatings of barite frequently cover the fossil ferns and calamites which occur in the carboniferous shales and fire-clay adjoining the semibituminous coal-seams of Broad Top Mountain.

3. Lancaster Station, Franklin Co. It occurs here in large white cleavable masses.

February 23, 1880.

New Localities for Chabazite.—Mr. Lewis Palmer announced two new localities for chabazite. It occurs in red crystals in a hornblendic gneiss at Waterville, near Chester, and also at Upland, Delaware Co.

On a New Ore of Antimony.—Mr. H. C. Lewis described an oxide of antimony found at Senora, Mexico, which he had been unable to identify completely with any known mineral. Under the supposition that it was a tin ore, it was sent to him by Mr. T. H. Shoemaker for examination.

The mineral generally occurs as a massive, compact, hard sub-

stance, with an imperfectly conchoidal cleavage and of a pale grayish yellow color. It also occurs as minute colorless octahedral crystals of glassy lustre. The crystals often occur in druses in the massive mineral, and are sometimes modified. Their form can only be distinguished with the microscope. Neither the crystals nor the massive substance show any colors in polarized light, and the mineral is therefore isometric. Special care has been taken to prove the identity of the octahedral crystals with the massive mineral. So far as could be determined with such minute crystals, their hardness and their behavior in the open tube were identical with the massive mineral.

The mineral here described has the following physical characters:

Isometric. Habit octahedral. Generally massive. Hardness, 6.5–7. Specific gravity, 4.9. Lustre of the crystals glassy; of the massive mineral sub-resinous or sub-vitreous. Color, pale grayish yellow. Streak uncolored. Transparent in crystals, opaque when massive. Fracture sub-conchoidal.

A thin section of the purest mineral examined under the microscope shows an entire absence of any foreign admixture. The structure is banded, the bands consisting of more or less opaque material, and the general appearance of the section recalling a section of muscular fibre. It has the following blowpipe characters:

On charcoal before the blowpipe, it is fusible with difficulty and decrepitates strongly. It gives a white coating of oxide of antimony, and fuses to a gray or bluish gray slag and is partially reduced to metal. With carbonate of soda on charcoal it is more readily reduced. In the borax and salt of phosphorous bead the slag dissolves and gives it generally a blue color, due to a trace of cobalt. In the closed tube it gives off water, decrepitates with violence, turns deep yellow when hot and becomes white when cold. It does not fuse or give a sublimate in either open or closed tube. When the slag formed by fusion on charcoal is moistened and placed on turmeric paper, it forms a brown stain.

The following are its chemical characters:

It is partially dissolved by digestion in concentrated hydrochloric acid, and by the addition of water to the yellow solution thus obtained white oxychloride of antimony is precipitated. It is decomposed with great difficulty, even after fusion with sodic carbonate and sulphur. On account of the difficulty of getting it into complete solution, no quantitative analysis has as yet been made. It has been found to consist mainly of oxide of antimony and to contain small percentages of lime, iron and water, and traces of arsenic cobalt, and lead. It has 3.1 per cent. of water. Until an exact analysis is made it will not be possible to determine its mineralogical equivalent.

Several tests indicate that the antimony exists mainly in the state of antimonious oxide. It differs from senarmontite and

valentinite in hardness, in fusibility and in solubility; from stibiconite in greater hardness, in its decrepitation, and in its occurring in crystals; from cervantite in its fusibility and in its behavior in the open tube; and from volgerite in the amount of water.

The massive mineral frequently contains crystals and small veins of quartz, and sometimes contains also small seams of a soft reddish yellow mineral which is probably stibiconite, a product of alteration.

Menaccanite from Fairmount Park.—Mr. JOHN FORD exhibited a fine specimen of menaccanite (ilmenite), found by Mr. G. Howard Parker in mica schist that had been quarried from the tunnel near Girard Avenue Bridge, Fairmount Park. Though associated with many others of like character, this specimen is probably the largest and most beautiful of any found in or near the locality named. It is quite lustrous in appearance, and measures about one-third of an inch in thickness by one inch in width. Its general form is that of an almost perfect half-circle, the whole being partly imbedded edgewise in a matrix of quartz.

It seems probable that the circular form of the crystal is due to its having been bent by the curving of the bed of schist in its earlier stages; but, of course, this can be little more than a supposition. The entire length of the crystal, measured around the curve, is about four inches.

MARCH 22, 1880.

On a Fault in the Trias near Yardleyville, Pa.—Mr. H. C. LEWIS remarked that it was not often that a section of a well-defined fault was exposed for study. Frequently a fault starts a line of erosion which obliterates all trace of it, and the actual junction of the faulted measures is either occupied by a stream or is so covered by talus that it can only be inferred from adjoining outcrops. He therefore thought that it might be of interest to describe a finely exposed fault which he had recently observed on the line of the Bound Brook Railroad.

Less than half a mile west of Yardley Station on the Bound Brook Railroad, a deep cut exposes a fine section of lower triassic shales and conglomerates. The fault occurs in about the middle of this cut. It may be seen on both sides of the railroad, but is finest on the north side. It is a fault between the lower white conglomerate and the overlying, but here adjacent, red shale. The fault runs north and south, or nearly at right-angles to the strike of the strata. The east end of the cut exposes conglomerate and sandstone, and the west end red shale, both of which are more or less decomposed and dip gently to the north. These formations are separated from one another by the nearly perpendicular walls of a trap-dyke, which occupies the line of fault.

The trap is entirely decomposed into a soft, clayey material of a black color, with specks of white, and is about 5½ feet in width.

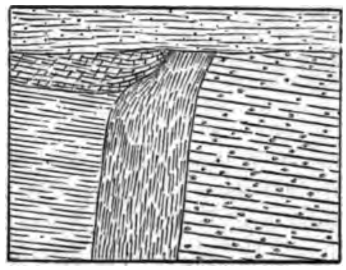


DIAGRAM OF FAULT NEAR YARDLEYVILLE.

The contact of the two differently colored formations with the black trap-dyke is very distinct, and is an instructive example of geological structure.

There has been apparently a downthrow of red shale and an upthrow of conglomerate, while an outburst of eruptive trap has forced its way along the line of fracture. It is of interest to observe that some strata of shaly yellow sandstone, overlying the red shale, have their edges *turned up* where adjacent to the trap, as though the fault had been caused by the pressure from below of the molten trap. That trap frequently exercises great mechanical force in its effort to break through to the surface, is shown by the fact that at several localities in Pennsylvania, the triassic shales in the neighborhood of a trap-dyke have their dip altered or even completely reversed. Near Taylorsville, for example, the writer has observed the dip of the red shales changed in the vicinity of a trap-dyke, from 20° N. 10° E., the normal dip, to 18° S. 80° W. Near Harleysville, also, a dyke below the surface has metamorphosed the strata into black argillite and reversed the dip to the south. It is probable, therefore, that the trap has been the direct cause of the fault which encloses it in the case here described.

MAY 24, 1880.

NOTES ON THE GEOLOGY OF RADNOR AND VICINITY.

BY THEO. D. RAND.

There has recently been published in the Proceedings of the American Philosophical Society (January to March, 1880; vol. xviii, No. 105) a paper read before the Society, January 2, 1880, by Charles E. Hall, on the Relations of the Crystalline Rocks of Eastern Pennsylvania, some of the conclusions in which so differ from my own observations that a statement of the latter may not be without interest, especially as regards the middle serpentine belt in Radnor, which I have been studying for some time.

Mr. Hall describes seven series of rocks and two serpentine horizons. Of these I have carefully examined but the second, fifth and seventh series and the serpentines. The second, he describes as "A series of syenitic, hornblendic and quartzose rocks, extending westward from Chestnut Hill, and covering a greater part of the northern portion of Delaware County."

These rocks, locally known in Delaware County as "Radnor Rocks," from their prevalence in that township, are in abundant outcrops in very many places, perhaps the most remarkable of which is a hill in the form of a truncated cone, perhaps 400 $\times$ 800 feet on the summit, with steep but not precipitous sides, 80 to 100 feet in height, situated in Chester County nearly south from Reeseville, and a prominent object in the landscape. North of these rocks occur those called by Prof. Rogers in the Geology of Pennsylvania, vol. 2, p. 72, primal older slates, and well described by him as follows:

"Metamorphosed with characteristic white streaks of imperfectly crystallized feldspar, and dark hornblendic material, with roundish specks of semicrystallized feldspar."

They are in fact gneiss, composed generally of thin layers of most varied character, feldspar being abundant, mica, hornblende and quartz varying in the layers from almost nothing to great abundance of one or the other; and many of these layers often appearing in an inch, giving at times a schistose character to the rock, but the mica or hornblende never so abundant that it can

properly be called schist. The minerals composing this rock closely resemble those of the gneiss on the south; so close is the resemblance of certain strata in the one, to some of the other, the difference being chiefly in mode of aggregation, that it seems to me not improbable that the northern are but upper strata of the southern gneiss.

The fifth group of Mr. Hall is described as "Hydromica schists, quartzose schists, chloritic schists and occasional beds of quartzite and sandy beds, and serpentines," of which he says, page 436: "These are the Hudson River shales and flank the Chester Valley on the south * * * the entire length of the Valley. They extend south to the syenitic rocks of the second group." Mr. Hall does not mention the schistose gneiss, nor is it possible to include it under his description of either the second or fifth groups which he places in contact. On page 441 he says: "The serpentines of Radnor Township, Delaware County, and those of eastern Willistown, east and west Goshen, are undoubtedly altered beds of the South Valley Hill slates or Hudson River slates. They lie unconformably upon the syenitic rocks of the second group." There are, as I have heretofore shown (Proceedings Acad. Nat. Sci., Philada., Nov., 1878), three approximately parallel beds of serpentine in Radnor Township. Presuming, as seems from the connection with the Chester County outcrops, that the middle and most conspicuous belt is intended, I cannot agree with Mr. Hall in his conclusions.

This middle belt is the largest of the three, and north of the syenite hill appears first on the Mattson's Ford or township line road, on the westerly side of a small affluent of the Gulf Creek, one-quarter mile northeast of Radnor Station, with a strike nearly E. and W. The serpentine forms a large hill, which begins abruptly and closely resembles in lithological character that of the Lafayette or Rose's quarry belt. The next or second outcrop is nearly west of this and is inconspicuous. The third, northwest of Radnor Station, is about 1000 feet in length. Its centre is nearly due west from the first; the strike is not far from N. 60 E. This outcrop ends abruptly. About 400 feet north is a small outcrop appearing as if the end of the ridge had been removed 400 feet northward. Beyond this I believe no outcrops have been described until we reach those near Paoli, but several exist: the fifth, nearly S. from Eagle Station, small and the strike indistinct;

the sixth, S. W. of Eagle, is S. 70° W. from the fifth, with a strike S. 40° W., dip about 75° to 80° S.; the seventh is nearly due W. from the fourth, its strike N. 50° to 60° E.; the eighth is a little S. of W. of the seventh, strike and dip not distinct; the ninth, that crossing the road running S. E. from Berwyn, and about a mile from that station, is at its eastern end S. 10° W. from the eighth, its strike is S. 40° W. The outcrop near Paoli is nearly W. from this, and extends thence as the wide and well-known belt passing one mile north of West Chester.

Now, examining the first outcrop, that on the Mattson's Ford road, we find on the S. the rocks of group one without doubt, but on the N. we find almost identical rocks—hornblendic gneiss, porphyritic gneiss and feldspathic gneiss. It is difficult to conceive that *these* are altered Hudson River shales. Beyond them are the primal older slates of Prof. Rogers, before referred to, then the northerly belt of serpentine, then gneiss, and occasionally (to the westward frequently) garnetiferous mica schist, then limestone, then trap, and then, fully one-quarter of a mile from the serpentine, the schistose rocks of the South Valley Hill, agreeing accurately with Mr. Hall's description of the fifth group. These intermediate beds thin out westwardly, until the serpentine, the trap and the hydromica schists of the South Valley Hill appear to come in contact.

The strike of the trap and of the southerly border of the schists, with which, in Radnor, it appears in contact, separating them from the primal older slates, being about S. 70° W., the serpentine and the schists are much closer at the western end of the Radnor Station outcrops, the intermediate strata thinning out as stated, and the serpentine perhaps crossing them in part; but even here, there is at least 800 feet of the schistose gneiss between them, with some garnetiferous mica schist, which seems to continue in a narrow belt close to the trap to near Paoli.

It will be noticed on the map accompanying Prof. Hall's paper, that this serpentine belt is made continuous from near West Chester into Delaware County in a straight line, except at the eastern end, where a marked southerly curve occurs near the line of Montgomery County, carrying the serpentine well into the rocks of group one. If my observations are correct, this line should be a series of disjointed lines, the easterly end of each more northerly than the westerly end of the succeeding; but, in

any event, if the map is correct as to the eastern extremity, the text is not so.

Mr. Hall's seventh series, page 436, is "The mica schists of Philadelphia * * * talcose schists, with soapstone and serpentine. They rest unconformably upon the first, second, third and fourth groups. * * * There are, besides these groups, probably two serpentine horizons, which are undoubtedly unconformable deposits above the second group. I think the northern belt of serpentine may be considered as altered Hudson River rock, while the southern belts are doubtful."

Page 441–442: "Dr. T. Sterry Hunt insists that the serpentines of the Schuylkill are below the Philadelphia schists. * * * At present I am inclined to place these serpentines above the Philadelphia rocks, and by so doing assign the Philadelphia series to a higher group than the Hudson River. * * * To all appearances the serpentine belts which are visible on the Schuylkill River at Lafayette Station, Montgomery County, and at a point just north of them, are above the mica schists of Philadelphia. The southern belt extends in an almost unbroken line from Chestnut Hill, Philadelphia, to Bryn Mawr, Montgomery County. A less prominent belt extends from the Schuylkill River to the neighborhood of Rosemont Station, on the Pennsylvania Railroad, in a parallel line to the first belt."

The meaning of the author in the two opinions first quoted, from pages 441–442, is not altogether clear. If there is dependence to be placed on lithological characteristics, the southern or soapstone belt continues far to the southwestward; as to it, I believe, belong the outcrops on Meadow Run, on both sides of Darby Creek, near Moro Phillips' chrome-mine, in Radnor Township; thence southwestwardly continuously through Newtown and Marple Townships. In this belt there is one rock described by me many years ago characteristic of it, and, so far as my knowledge extends, confined to it (except outcrop at Rosemont hereafter referred to) a steatite filled with crystals of serpentine pseudomorphous after staurolite. This rock is very abundant and prominent from Chestnut Hill to a point a short distance west of Mill Creek, and is found also, but not abundantly, west of Darby Creek. The northeasterly portion of this belt contains very little serpentine; steatite and chlorite constitute the greater part of its mass. Its strike is about S. 52° W., its bounding

rock is the well-known wood-like garnetiferous schist; partially altered rocks found at the soapstone quarry on the Schuylkill seem to show that it has arisen from the pseudomorphism or metamorphism of interstratified hornblendic and micaceous gneiss and schists. It contains quite a number of minerals. The northerly belt, on the contrary, is little else than a very dark, almost black serpentine; except chrysotile and asbestos, and some talc and chlorite, it is almost destitute of minerals, and at Rose's quarry has undoubtedly been formed, not from Hudson River shales, but from a hard, compact enstatitic rock visible there in place, and this rock appears to be unstratified. It extends from the Schuylkill S. 59° W. 1⅝ miles to a point on Barr's farm, where, as a hill, it suddenly ends, but it may be traced by fragments to an outcrop in the Conshohocken road, near the house of William Schalliol, and to the south of the former line of strike. Thence it crosses the road to Bryn Mawr east of a small stream, with a course about S. 35° to 40 W., and after crossing seems to curve even more southwardly, but this is on a hillside and is probably due to creep. About 400 yards beyond, in the same direction, fragments are abundant in a field. Through this portion the rock on the north appears to be a very thin bedded compact gneiss, with two, and often three, easy cleavages, together with a peculiar schistose feldspathic gneiss, in which the mica is in small masses or isolated crystals, generally with curved surfaces, remaining brilliant on exposure. On the south the rock is a schist, micaceous or chloritic, but garnets are almost and perhaps wholly absent. North of this about 250 feet, just at the crossing of two roads, is an outcrop of serpentinous rock, or a hornblendic rock partially altered to serpentine, very different from that in the southerly outcrop, and about 1400 feet S. 60° W. a similar rock appears in quantity forming a small hill. East of the Gulf road, and about S. 43° W. from the last, fragments are found in the soil. West of the Gulf road is a conspicuous bluff of serpentine dipping southwardly, and S. 45° W. an outcrop at Rosemont Station, where it has been quarried. At this point the rock resembles that of the soapstone belt, and is wholly unlike that of any other part of this, which elsewhere closely resembles that near Radnor Station.

Mr. Hall makes no mention of the Potsdam sandstone on the south side of the Chester Valley, further than in his fifth group mentioning sandy beds.

Finding, as we do, as has been described by Mr. H. C. Lewis and myself, extensive deposits along the base of the South Valley Hill, not only of a remarkably white sand, but of large masses of compact sandstone, very closely resembling that of the North Valley Hill, and the same rock, much decomposed, being found in the valley south of the South Valley Hill, accompanied by iron ore as at other places, and finding it nowhere else in the very great exposure of the hydromica schist rock of the South Valley Hill, it would seem more likely to be the Potsdam found in the same position east of the Schuylkill than mere accidental beds of sandstone, intercalated in the schists just at those points.

A trap-dyke has been referred to as lying between the hydromica schists of the South Valley Hill and the rocks on the south of it. This is prominent from the Schuylkill for about three and one-half miles to the farm of Mr. Frank Fennimore, near Wayne Station. Here it appears to widen out, and perhaps to divide into two branches, one crossing the railroad and turnpike between Wayne and Eagle, and being very prominent south and southwest of Eagle store, with a strike approximating S. 60° W. and completely within the gneiss; the other branch, or a distinct dyke, accompanying the serpentine in a more nearly due west direction. A mile southeast of Berwyn, the latter can be seen almost if not quite in contact with the serpentine, the trap, however, being on the *south* of the serpentine. The same is true south of Paoli, except that the trap appears to be on the north side. Prof. Rogers, page 168, speaks of this trap as "occurring along and outside the northern edge of the serpentine, in a succession of narrow elongated dykes, ranging more N. E. and S. W. than the serpentine." These I have not examined, but such structure agrees precisely with what I have observed of the serpentine further east.

South of the serpentine, perhaps from a bed in the Radnor gneiss, occur in the fields, often abundantly, a white quartz, weathering yellow on the surface, except certain portions which remain white. The form of many of these seems to forbid the idea of mere accident, and to suggest that they may be due to the remains of organic material which have deoxidized the contained iron, and thus facilitated its removal.

Note on Damourite from Berks Co., Penna.—Mr. F. A. GENTH, JR., remarked that a short time ago Mr. H. W. Hollenbush, of

Reading, Pa., gave him a specimen of a shaly mineral having a talcose to serpentine-like appearance, but which, when examined chemically, proved to have the composition of a damourite or mica.

It is found at Rockland Forges, Rockland Township, Berks Co., about three miles northeast from Friedensburg, and occurs as a massive pale grayish-green to light brown mineral with a more or less pearly lustre. Prof. Prime has also sent it from a locality about two and one-half miles south of Blandon; this specimen is of a pale green color with a somewhat silky lustre, H = 2 — 2.5. G = 2.85, streak white; feel smooth, sometimes slightly greasy; odor argillaceous; massive, lamellar; translucent in thin fragments.

An analysis of the Blandon specimen by Dr. Genth gave him:

Ignition,	4.86
K_2O,	9.53
Na_2O,	0.36
Fe_2O_3,	2.94
Al_2O_3,	32.11
MgO,	tr.
	99.40

An alkali determination of the specimen from Rockland Forges, gave $H_2O = 5.60$, $K_2O = 10.32$, Na_2O — 0.36, which proves the mineral to be a variety of mica or muscovite.

Associated with it is found a grayish to reddish white opaque mass of quartz, in the Rockland, and rounded grains of quartz in the Blandon specimen, the latter having a somewhat conglomerate-like appearance.

JUNE 28, 1880.

On the Stalactites of Luray Cave.—Dr. A. E. FOOTE gave a description in detail of a cavern near Luray, Va. He gave a sketch of the geology of that region and described his visit to the cavern. A number of remarkably symmetrical white and translucent stalactites were exhibited. The rapid growth of the stalactites and stalagmites, and their enormous size, were mentioned. Curled and twisted stalactites slightly resembling Flos-ferri were exhibited. It was shown that the curling and twisting was due to the fungi which, in the remarkably damp atmosphere of this cave, grew upon the surface of the stalactites and caused the water to deviate from its natural course. Over the surface of the fungus knob-like excrescences and even long lateral branches of carbonate of lime were formed.

New Localities for Gypsum.—Mr. LEWIS reported two new localities for gypsum: Smith's quarry, Easton, where it occurs in tabular crystals; and Richmond coal-field, Chesterfield Co., Va., where it occurs in crystals and in snow-white masses in triassic strata.

SEPTEMBER 27, 1880.

A New Locality for Sphene.—Dr. A. E. FOOTE described the new locality for sphene and associated minerals at Eganville, Renfrew Co., Canada. The sphene occurs in immense crystals, weighing from 20 to 80 lbs., in a vein of apatite 20 feet wide. Many other veins of smaller size occur in the same county.

The rock is principally Laurentian gneiss and granite. A solid mass of sphene, very highly cleavable ($5 \times 2 \times 2$ feet), was observed in the side of the vein. It yielded several hundred pounds of sphene. Close by it doubly-terminated crystals of scapolite, weighing over 50 lbs., and crystals of pyroxene, weighing from 12 to 30 lbs., were found. Phlogopite and zircons, some of them twinned, occur at the same locality. From the enormous size of all the crystals found in this county, it must rank as one of the most remarkable mineral localities known. When the vein, 20 feet wide, spoken of above, was discovered, a doubly-terminated crystal of apatite, weighing 500 lbs., and bright upon the surface and ends, was said to have been found.

OCTOBER 25, 1880.

A New Locality for Hyalite.—Mr. H. C. LEWIS reported that he had found hyalite forming green, glassy coatings on hornblendic gneiss at a quarry on Mill Street, Germantown. The mineral has the usual mammillary or botryoidal surface, is perfectly transparent, and has a beautiful light green color. The color is due to the presence of copper, as shown by blowpipe tests.

Note on Autunite.—Mr. H. C. LEWIS remarked that he had recently investigated the optical character of the Fairmount autunite. His examination confirmed the orthorhombic character of autunite. The bissectrix is normal to the main cleavage-plane, and parallel to the secondary diagonal planes. The optic axial divergence is 24°. The autunite from Limoges, France, has an optic axial divergence of about 38°.

DECEMBER 27, 1880.

Crystalline Cavities in Agate.—Mr. THEO. D. RAND exhibited three specimens of agate, locality unknown, in the centre of each of which was a cavity with plane sides, and casts of these cavities showing them to have been calcite crystals. The method of taking these casts, the sides of the cavities being rough with re-entering angles, was explained. A solution of glue, with about one-fifth of glycerine, of such consistence as to form a thick, firm jelly when cold, but to be perfectly fluid when hot, was prepared and heated. The specimen was then cooled to about 32°; a rough splinter of wood was inserted in the cavity which was previously moistened with cold water. A drop or two of the glue solution

—hot—was poured in and allowed to become firm. The wood was then carefully moved until the glue was detached from the stone, but not removed, or if removed the splinter marked so as to be returned to the same position. More glue was then poured in and the operation repeated. A mould was then made of the glue in plaster, and from this type-metal casts obtained.

JANUARY 24, 1881.

Note on Halotrichite.—Mr. LEWIS described two localities of halotrichite in the neighborhood of Philadelphia, and exhibited specimens. It occurs in fine incrustations on hornblendic gneiss on the river drive below Strawberry Mansion, Fairmount Park, and it occurs as an impure efflorescence at the West Jersey marl-pits, where it is mixed with sulphatite and melanterite.

On Twin Crystals of Zircon.—Dr. A. E. FOOTE recorded the discovery of perfect twin crystals of zircon, near Eganville, Renfrew Co., Canada. He had obtained small but imperfect twin crystals over four months before, but sufficiently distinct to establish the character of the twinning at that time. As in cassiterite and rutile, the twinning plane is 1 — i. It is doubtful if twins of zircon have ever been seen before.

APRIL 25, 1881.

Note on the Drift of Lycoming County, Pa.—Mr. ABRAHAM MEYER contributed some observations on the rocks and drift of Lycoming County, and especially of that portion in the vicinity of Lycoming Creek. He described the exposures on Lycoming Creek and commented on the various theories proposed to explain the geology of the county. He drew attention to the ridges of drift ("stony batter") on Lycoming Creek and on Hogelan's Run, which he supposed were formed by glacial action. He had found pebbles of granite and of hornblendic gneiss with magnetite in several places in Lycoming and Tioga Counties, and hoped that a careful study would be made of that region.

Discs of Quartz between Laminæ of Mica.—Mr. THEO. D. RAND exhibited a curious form of quartz occurring between the laminæ of muscovite, from Amelia Co., Va. Part of it was crystallized in the common form, but part was in discs, one-tenth of an inch in diameter and less, which, with polarized light under the microscope, showed a black cross which rotated as the analyzer was rotated. He stated that these disks were much like those from Swaim's quarry, Chester Co., Pa., hitherto undetermined, but much larger than the latter, and that it was probable those from Swaim's were also quartz.

On Two New Localities of Columbite.—Prof. H. CARVILL LEWIS announced two new localities for the rare mineral, Columbite. Only a single specimen of this mineral has been described from Pennsylvania. An imperfect crystal was found in Nivin's quarry, Chester County, by Mr. Tyson, and noticed by Dr. Genth in his Mineralogy of Pennsylvania (p. 137).

Attention is now drawn to a beautiful doubly-terminated crystal which was found at Mineral Hill, Delaware County, and which is now in the cabinet of W. S. Vaux, Esq. The crystal is black, with a slightly iridescent surface, and is of about seven-eighths of an inch in length and half an inch in width. The following planes are present and have been determined by a hand goniometer, viz.: the macropinakoids $i\,\bar{i}$, the brachypinakoids $i\,\breve{i}$, the prisms I, the brachydiagonal prisms $i\,\breve{3}$, the basal pinakoids O, the brachydomes, $2\,\breve{i}$, and the brachydiagonal pyramids $1\,\breve{3}$.

The second locality is the well-known Dixon's quarry, Delaware. There is a large fragment of a crystal in the collection of the Academy marked on the authority of T. Fisher as from this locality. The specimen weighs over half a pound. Its nature was determined by its physical and blowpipe characters.

The occurrence of columbite at these localities is of some geological interest in connection with the determination of the age of the formation containing it, since the associated minerals are similar to those at the columbite localities of Massachusetts and Connecticut.

On the Occurrence of Fahlunite near Philadelphia.—Prof. LEWIS stated that he had found Fahlunite at two localities in the belt of hornblendic gneiss which crosses the northern part of the city. This belt of hornblendic gneiss, especially at its exposures at Frankford and near Germantown, has already yielded many minerals of interest, but fahlunite has not hitherto been noticed in Pennsylvania.

Fahlunite occurs disseminated in irregular masses in orthoclase at McKinney's quarry, Rittenhouse Street, and at Nester & Shelmire's quarry, on Wayne Street, Germantown. Only one specimen was found at the latter place. At McKinney's quarry it occurs in small, pale green masses, somewhat after the manner of the apatite of that locality. It has a scaly structure and a felspathic cleavage. It has a hardness of about 2.5. Its color is pale apple-green, and when heated it turns dark gray. It fuses at 4.5 to a dark grayish green opaque glass. It is nearly insoluble in acids. A rough analysis, made by fusing the mineral with sodic carbonate, showed that it consisted principally of silica and alumina, while containing small quantities of iron and magnesia and traces of lime and soda. It contains 2.8 per cent. of water. Although less hydrous, it resembles the variety of fahlunite

known as chlorophyllite, and is perhaps intermediate in character between pinite and fahlunite.

All the specimens as yet collected have the aspect of pseudomorphs by alteration. Frequently there is no distinct line of demarkation between the fahlunite and the surrounding orthoclase, as though one passed into the other. At the line of junction the orthoclase sometimes becomes dull, while the fahlunite, which has its normal character in more central portions of the mass, becomes hard and resembles a greenish orthoclase. These features may be seen in the specimen presented to the Academy.

May 23, 1881.

On the Fossil Ores of Lycoming County.—Mr. Abraham Meyer described some outcrops of fossil iron ore in Lycoming County. He stated that the ore of Larry Creek formed veins having an average width of 2 feet, but occasionally being 4 feet thick. Those veins which are inclined at a high angle (70°–80°) show slickensides on their surfaces, while the more horizontal veins have an oolitic structure. They yield 40 per cent. of metallic iron, although stated by the Geological Survey (Report F, p. 235) to contain only 16 per cent. Nodules of ore from Beatty's Run frequently contain a nucleus of carbonate of iron.

September 26, 1881.

On a Mineral resembling Dopplerite from a Peat-bed at Scranton, Pa.—Prof. H. Carvill Lewis called attention to a very interesting substance recently found in a peat-bog at Scranton. In an excavation for the new court-house at that place, below a deposit of peat, "swamp-muck," and fallen trees, at a depth of some 25 feet from the surface, there occur veins of a black elastic substance which, when first excavated, was a stiff black jelly, but which after drying becomes brittle and nearly as hard as coal. The dried mineral resembles jet, having a brilliant lustre and a conchoidal cleavage. The peat-bog in which this substance was found is said to have been formerly a swamp or lake, which has been filled up in the extension of the town. The deposit of peat, which is covered by about 10 feet of rubbish, is over 15 feet in thickness and is said to burn well. Near the bottom of the peat, in a carbonaceous clay or "muck," the black jelly-like substance is found. It occurs in irregular veins, sometimes nearly perpendicular, throughout the lower portion of the peat, and these veins vary in thickness from a mere stain to 2½ inches. Immediately below this deposit, and underlying the whole peat-bog, is a deposit of glacial till or "hardpan." This peat-bog, therefore, like the others so numerous throughout the glaciated region, is of post-glacial age.

When the substance here described was first received, last July,

it was soft, black and elastic, having a hardness of less than one, and being almost jelly-like in consistency. After partial drying it was nearly as elastic as india-rubber. When a very thin slice was cut by a knife and examined under the microscope, it appeared brownish red by transmitted light, and was nearly homogeneous in character. It was imbedded in and surrounded by peaty matter, the latter being filled with plant remains. Occasional oval seeds are imbedded both in the peat and in the jelly-like substance. After drying for three months in the air the mineral was found to have a hardness of 2.5, and to have become brittle. The dried substance has a brilliant resinous lustre and a conchoidal fracture. It has a specific gravity of about 1.036. It is jet-black in the mass, but its powder has a dark brown color. In the closed tube it yields water and abundance of brown oil and empyreumatic vapors. The air-dried substance burns with a yellow flame while held in the flame of a Bunsen burner. In its natural elastic state it burns slowly without giving a yellow flame. It does not dissolve in ether or alcohol, but is entirely dissolved by caustic potash; and from the dark brown solution thus formed may be precipitated in reddish brown flocculent masses by the addition of acid. The filtrate from this precipitate has a pale yellow color. These are the properties of humic acid, and it is probable that this substance is an acid hydrocarbon closely related to that acid.

It is evident that this substance is the direct result of the decomposition of the surrounding peat. It may be of quite recent formation. It is of special interest in that it appears to be an intermediate product between peat and true coal, and it illustrates one method of change from the former into the latter.

In many of its characters this substance closely resembles dopplerite. Dopplerite is a black jelly-like substance, occurring in the peat-beds of Austria and Switzerland. In its method of occurrence it is precisely similar to the Scranton mineral. On exposure it hardens to a hard jet-like substance, which, however, unlike the Scranton mineral, does not burn with a flame. Dopplerite has been regarded as a truly homogeneous peat, and has been shown to have the same composition as that substance. It has never been identified in America. Whether the mineral from Scranton is to be regarded as dopplerite can only be determined after analysis. It is worthy of careful examination.

TITANIFEROUS GARNET.

BY H. A. KELLER.

At Darby, in an almost horizontal rock-stratum, I found the following very interesting occurrence of what seemed at first sight black garnets. The stratum itself is a very much weathered mica schist, 6 to 7 inches in thickness, which contains this often very much decomposed mineral as harder aggregations. The stratum is enclosed by two layers of milky quartz, each about 2 inches in thickness, to which harder less decomposed crystals of a rhombic dodecahedral shape firmly adhere. These very hard crystals are usually of a jet-black color, with vitreous, sometimes metallic lustre, passing however often into the very characteristic reddish-brown garnet substance.

The specimens I found are therefore of two kinds: 1. The very much decomposed aggregations found in the midst of the mica schist. These consist of loose granules of still unaltered garnet mixed with the separated SiO_2. They are only imperfectly held together by cohesion. 2. The hard, jet-black, sometimes partly brown crystals (∞ 0) firmly attached to the quartz lying above and below the hydromuscovite. Their hardness is 7, sp. gr. 4.25, they have no streak and are not magnetic, but possess a most remarkable cleavage parallel to the dodecahedral faces. Their composition,

SiO_2	36.92
TiO_2	1.14
FeO	27.36
Fe_2O_3	3.74
Al_2O_3	26.54
MnO	.33
CaO	2.76
MgO	1.66
	100.45

together with their appearance under the microscope, shows that there is a very intimate dissemination of a Ti Fe mineral in the garnet substance. Many of these crystals have from within become partially altered, so much so as to have often formed inside of even the hardest ones small but well-crystallized sphenes, others have changed into asbestos, mica, quartz, and even pyrite.

Their outer shape has generally by transformation become partially lost in the surrounding hydromuscovite. The Ti has probably been furnished by the two quartz strata, as I have observed, only a few feet distant, many other pieces of quartz impregnated with the same black mineral, while the enveloping strata were perfectly free from it, or had it only partly remaining as the more insoluble FeS_2.

OCTOBER 24, 1881.

Pyrophyllite and Alunogen in Coal-mines.—Mr. ELI S. REINHOLD made the following communication:

About two years ago the writer discovered in the coal slates of the North Mahanoy colliery, near Mahanoy City, Schuylkill County, an interesting mineral which, in its determination, defied the ordinary tests based on physical characters. A chemical analysis by Dr. F. A. Genth proved it to be an interesting variety of pyrophyllite. His report to the American Philosophical Society gives the results of the analysis, together with information as to occurrence, etc.

Attention is here called to that report for two reasons: First, for the purpose of making a correction; and, second, for a possible connection between pyrophyllite and the recently discovered alunogen.

When the writer furnished Dr. Genth with information regarding the pyrophyllite, he stated that it was found in but *one vein, of only one mine.* He has since found it at four different collieries, and coming from, at least, three different coal-veins.

Alunogen.—In a valley extending northeast from Mahanoy City, a distance of about a mile, are a number of collieries. A stream of water flows through it, receiving the mine-water from several of these collieries. During heavy rains the stream overflows its banks and covers a large area with the sulphur-water. The writer noticed, last spring, after the water had subsided, a white mineral coating the surface recently inundated. This mineral proves to be alunogen. In this efflorescent form it has been more abundant this summer than before.

As foreign mineralogists have noted the occurrence of this mineral in the coal-slates of Bohemia, Bavaria and England, and as the same mineral is common in our own State, as an efflorescence where iron-sulphide comes in contact with clay, its discovery here in the anthracite coal region may be regarded quite natural rather than surprising. However, there is a hint at a different origin of the alunogen found here from that ordinarily given. Instead of it being the result of the sulphur contained in the mine-water uniting with the alumina of the slate, the writer is inclined to think that the latter constituent is furnished by the

rapidly decomposing pyrophyllite, which contains fully 27 per cent. of alumina. This opinion is based on two facts:

1. Only since pyrophyllite has become abundant has this efflorescence been noticed.

2. Only at collieries where pyrophyllite is found, can traces be found of the alum deposit.

I propose to make some experiments that may throw further light on the subject; but facts, as far as observed, point to this origin of a mineral not heretofore credited to this locality. It adds one more to the extremely limited list of minerals found in the anthracite coal-field.

New Locality for Mountain Cork.—Theo. D. Rand announced a new locality for mountain cork, about one-third of a mile northwest of Radnor Station, P. R. R., Delaware Co., Pa., where it was found by him in the soil overlying the serpentine belt.

A New Locality for Aquacreptite.—Mr. G. Howard Parker announced a new locality for aquacreptite. He had found it as a seam or vein in partially decomposed micaceous gneiss on Lansdowne Avenue, 1½ miles west of Hestonville, Philadelphia.

Note on Aquacreptite.—Prof. Lewis remarked that as bearing upon the genesis of aquacreptite, it was of interest to observe that at each of the three localities where that mineral had been discovered the rock enclosing it was different from that at either of the other localities. Aquacreptite was first found at Strode's Mill, Chester County, by Mr. Jefferis, as long ago as 1832. It was known by local mineralogists under various names until described by Prof. Shepard, in 1868, as a new mineral. At this, the original locality, it occurred in serpentine. The second locality, near Marble Hall, Montgomery County, was discovered by the speaker in 1872, and is mentioned in Dr. Genth's Report on the Mineralogy of Pennsylvania. It here occurs in a pocket in limestone. At the third locality, West Philadelphia, now reported by Mr. Parker, it occurs in gneiss.

From the existence of aquacreptite in these diverse rocks, it seems probable that its origin cannot be ascribed to any direct alteration, but that, as in clays, it is in part mechanical.

Aquacreptite is a variety of bole, differing from other varieties in the greater degree of decrepitation which it undergoes when placed in water. Some time ago the speaker had made some experiments to determine the cause of this remarkable decrepitation. He had found that it was a purely mechanical action due to capillary attraction. When the porous mineral is suddenly immersed in water or any other liquid, the liquid enters its pores so rapidly as to split it open. If, however, it is gradually moistened and the enclosed air is replaced slowly by liquid, no decrepitation takes place upon subsequent immersion. That no

chemical action takes place is shown by the fact that if, after the decrepitation of the mineral, the fragments are dried, these fragments will again decrepitate when immersed in liquid, and this operation can be repeated as long as any fragments of sufficient size remain. Decrepitation takes place, whatever liquid is used, varying in degree with the mobility of the liquid employed. While very energetic in boiling water, it takes place with great slowness in sweet oil. The decrepitation of the aquacreptite of the three different localities varies also with the density of the specimens. The West Philadelphia mineral decrepitates and gives out bubbles the most rapidly, and the Chester County mineral the most slowly of the three. In some of the Chester County specimens decrepitation takes place very slowly in cold water, being most slow in the most compact specimens. The aquacreptite from Marble Hall falls to the smallest fragments. The hardness varies in different specimens from the same locality, the most variable, being however, at the Chester County locality. In general, the aquacreptite of the three localities has the following hardness, viz.: Chester County, > 2; Marble Hall, $= 2$; W. Phila., < 2.

The emission of air-bubbles, and the phenomenon of decrepitation when immersed, may be observed in a less degree in several of the varieties of bole; and it is questionable whether a greater amount of a purely mechanical action entitles a substance of probably mechanical origin to a special mineralogical name.

Quartz Crystals from Newark, Del.—Mr. W. W. JEFFERIS stated that he had found a number of doubly-terminated quartz crystals lying loose in the soil at a new locality, near Newark, Delaware.

NOVEMBER 27, 1881.

Some Ochreous Deposits of Kentucky and Indiana.—Prof. R. B. WARDER made the following communication:

At the village of Francisville, Boone Co., Ky., a ferruginous mass crops out in the road; and a specimen of it is herewith exhibited. It consists chiefly of sand, clay and ferric hydrate, with smaller quantities of manganese and lime. A few rods north of this outcrop are many drift pebbles and some boulders; but the largest grain of sand observed in the ochreous mass was less than four millimetres in diameter. The whole bed seems to consist of rather finely pulverized siliceous drift materials, cemented with a considerable amount of iron; it resembles bog iron ore in appearance, but it probably contains too small a percentage of iron to rank as an ore, and the bed is of very limited extent.

In the neighboring parts of Indiana, very similar deposits occur at several points in Dearborn, Ohio and Switzerland Counties,

which I described in 1872.[1] These outcrops resemble that at Francisville, not only in the character of the materials, but also in their topographical situation and in the character of the neighboring soils, being found in most cases in the portions designated as "broken upland,"[2] about 300 to 400 feet above the level of the Ohio River.

The question naturally arises whether these various beds are of separate origin, or whether they are detached remnants of extensive bog deposits, stretching across the area now occupied by the river and its bottom.

The beds just described may be compared with certain masses of sand and pebbles, firmly cemented with ferric oxide, which occur in the neighborhood of Philadelphia, and are known as "Bryn Mawr gravel." These beds (as I was told by Prof. H. C. Lewis) occur on both sides of the Delaware, at an elevation of at least 400 feet above that river. The Bryn Mawr gravel, then, resembles the ochreous deposits described in this paper in the general character of the materials, the topographical situation, and the mode of occurrence; but differs in containing much coarser drift, more firmly cemented, and probably contains a less percentage of iron.

Some Philadelphia geologists regard these scattered deposits of cemented gravel as fragments of one extensive bed. Further study of the ochreous deposits described above, may yield an interesting chapter of recent geological history.

A New Mineral from Canada.—Dr. A. E. Foote called attention to some very peculiar olive-green crystals which he had noticed associated with the remarkable white garnet found by him in Hull, Province of Quebec, Canada. From the few tests he had applied he thought it might be new, and had sent the material to Mr. E. S. Dana for examination.

A Peculiar Twinned Garnet.—Mr. W. W. Jefferis exhibited a curious twinned garnet, in which the smaller crystal fitted loosely into a cavity in the larger. The smaller crystal was of lenticular shape, and could be detached from the larger one, whose dodecahedral outline it seemed to complete. He had found it at Avondale, Chester County, a locality which has furnished several hundred good crystals of garnet, from one to three inches in diameter.

[1] Geol. Survey of Ind., 1872, pp. 419, 420.
[2] Geol. Survey of Ind., 1872, pp. 389 and 423.

DECEMBER 23, 1881.

ON DIORITE.

BY ELI S. REINHOLD.

Several years ago I received a box of minerals from Placer County, California, which contained a specimen marked "Hornblende," so peculiar in appearance, that I laid it aside for special examination.

I herewith send the specimen, which proved to be diorite, a rock of volcanic origin. The arrangement of the hornblende and feldspar is different from that of any trap-rocks of same composition in the Eastern States, with which I am familiar. The centre of each nodule is composed of crystalline granules of the two minerals, hornblende and feldspar; this is enveloped by a zone of clear white feldspar, followed by another of both minerals in which the crystals are radiately arranged, at least sufficiently so to make it apparent to the unassisted eye. Another band of feldspar, less pure, however, than the first, is followed by a zone of hornblende which shades off into the coarse, crystalline, granular matrix of hornblende and feldspar of no defined arrangement.

Not having access to any lithological collection, nor even to the books descriptive of all the varieties of greenstone, I may overestimate the interest of this California rock.

A description before me of a diorite found in the Island of Corsica, known as Napoleonite, answers to many points in this specimen. The nodular masses of the Corsican greenstone are described as globular, while in the California rock they are oblate-spheroidal. It would be a matter of interest to ascertain what member of the feldspar group is represented in this rock. All my books agree in assigning the mineral in diorite (generally) to the *triclinic* feldspars; but some give labradorite, others oligoclase and albite; while another author calls it a mixture of anorthite and albite. Either the feldspar in diorite from different localities varies, or else opinions in reference to it are very diverse.

Locality is marked on specimen label.

A New Locality for Allanite.—Dr. Isaac Lea presented a specimen of allanite and zircon, in quartz rock, which he had found at Yellow Springs, Chester County; this being a new locality for allanite.

A New Locality for Copiapite.—Mr. E. S. Reinhold presented a specimen of copiapite which he had found at Mahanoy City. It had been identified by Prof. Lewis, and is now announced as from a new locality.

NOTES ON THE GEOLOGY OF LOWER MERION AND VICINITY.

BY THEO. D. RAND.

Of much interest to those interested in mineralogy and geology in Philadelphia is the last volume, C^6, published by the Geological Survey, covering the geology of Philadelphia County, and of the southern parts of Montgomery and Bucks, by Chas. E. Hall, with a letter of transmittal by Prof. J. P. Lesley, but I think those acquainted with this region must regret that the publication was not delayed until the adjacent parts of Delaware County were examined, and until more time could be given to the work reported on, that it might be as near perfection as possible.

Mr. Hall's conclusions are at variance with all our preconceived opinions; but that is no reason for their rejection. If his data are correct, his conclusions seem almost necessarily to follow; but it is impossible for any one familiar with the district to examine the map and text without a feeling that longer study might have modified the author's views. All will agree with him as to the difficulties to be encountered; but this should have induced the greater care. In Mr. Hall's letter he states (p. xvii), "It has been my object to locate accurately the areas of the different belts of the metamorphosed rocks." And in Prof. Lesley's letter of transmittal (q. v), "Mr. Hall has not only studied every individual exposure at least once, and the more important ones repeatedly, but has obtained from them several thousand hand specimens."

If, as a test, we examine upon the map the serpentine outcrops, which are generally so easy of identification, we shall be disappointed. For instance, tracing the steatite belt westward from the soapstone quarries on the Schuylkill, the very distinct outcrop at the corner on Hagy's Ford road, at the road crossing, one mile from the Schuylkill, is wholly omitted. The outcrop on the Black Rock road is represented as extending of a width of about 200 feet for about 900 feet eastward of the old Gulf road, $1\frac{7}{8}$ miles from the Schuylkill, while it is, at that point, over 1000 feet in breadth, and extends, though probably narrowing rapidly, fully 2000 feet eastwardly. West of this road, its location on the map is southward of its true position. This portion of the belt is made to end a short distance east of the Roberts road; whereas, on that road, it appears in place, with the garnetiferous schists

bounding it on the north, a most distinct outcrop of over a hundred feet in width. Beyond this it is not shown until the Pennsylvania Railroad, at Bryn Mawr, is reached, where a very distinct outcrop 400 feet wide and 1500 feet long is delineated, just below the bridge at Penn Avenue.

The outcrop on the Roberts road can be followed by abundant fragments in the soil to a point where the southward course of the Black Rock road changes to W. S. W., just north of which a very distinct outcrop is visible in the side of the road.

I am quite familiar with the railroad cut at Bryn Mawr, which is through decomposed mica schists. I have searched in vain for the slightest evidence of steatitic or serpentine rocks in it. Recently the cut was widened. Taking advantage of the fresh exposure, I obtained specimens below Penn Avenue about every ten feet from 150 feet to 400 feet, including a light-colored stratum differing from the bright-colored decomposing schists elsewhere. All, without exception, were unmistakably decomposed mica schist with quartz. I believe, therefore, that serpentine and steatite do not there exist at or near the surface.

Examining the more northerly belt, that north of Lafayette Station, we find it represented as ending about 2000 feet west of the Schuylkill. There is, it is true, an apparent break in the belt at this point, and, as it were, a fault, throwing the westerly continuation southward; but the break is small, and the belt can be traced by abundant surface fragments to a point between 3000 and 4000 feet from the river, where another fault occurs (or a change of direction more northwestward) and an outcrop in place appears east of a road about a mile from the Schuylkill. Thence, on the map, the outcrop appears continuous; whereas, at the next road, where there is a gap through which a stream passes, there appears to be a fault, the westerly continuation of the belt being, as it were, shifted northwardly more than its width, showing on a small, but very distinct scale, the echelon structure so marked in the belt north of the syenite. The outcrop is represented as ending east of the old Gulf or Conshohocken road; whereas it can be traced by fragments, and one outcrop in place, to the new road to Bryn Mawr at the crossing of a branch of Mill Creek, on the lands of Yocum and Shalliol, where a large distinct outcrop in place occurs, whence it can be followed by surface fragments in a more southwesterly direction (S. 35° W.), than the

easterly part of the belt, (S. 40° to 50° W.), probably 1000 feet. About 250 feet northward from this, and eastward of its ending, is another outcrop of serpentinous rock (another instance of echelon structure?). About 1400 feet S. 60° W. is another outcrop, forming a distinct small hill not upon the map, and other minor outcrops further westward. The character of rock in the outcrops adjacent, north and south, above mentioned, is different in each. The southerly is talcose and chloritic, the northerly a hornblende-like rock altered into serpentine or some allied mineral.

The outcrop at Rosemont, Pennsylvania Railroad, from which much stone has been quarried, is not upon the map.

An outcrop of serpentine is delineated northeast of the crossing of the Gulf road and the Mattson's Ford road, or Township Line road, and (p. 3) located northwest of Mechanicsville.[1]

The rock at the point indicated on the map, which is within one-eighth of a mile southeast of Gulf Mills, and over one-half mile southwest of Mechanicsville, is altered hydromica schist. It bears a remarkable resemblance to the decomposed schists in the cut of the Pennsylvania Railroad at Bryn Mawr. There are outcrops of serpentine, one in place on the Gulf road, about 500 feet S. S. E. of the cross-roads; the other, fragments in the soil, about 700 feet southeast. There is also an outcrop of similar serpentine, with steatite, on the Mattson's Ford road, just east of the Delaware County line. This is not upon the map. These outcrops, and another westward, were described in the Proceedings Acad. Nat. Sci., 1878, page 402, as belonging to a then undescribed northerly belt.

Mr. Hall (page 89) connects that on the Gulf road with the great belt passing through Radnor and through Chester County. He evidently has not examined the westerly outcrops.

The limestone in Upper Merion, just north of Gulf Mills (the south end of the Gulf), interesting in connection with that a mile farther up the Valley, is not upon the map, nor the eurite and the garnetiferous schists southeast.

Turning to the text, we find it stated (page ix) that "The ser-

[1] On the map the name Mechanicsville appears to be given to the settlement at the south end of the Gulf, correctly Gulf Mills, which name it has borne for much over a century. Gulf Mills, on the map and in the text, is applied to McFarland's Mills at the north end of the Gulf. Mechanicsville is a small town, formerly known as Rebel Hill, in a gap over one-half mile south of the Gulf.

pentine belt of Bryn Mawr, instead of passing in a straight line southwest through Delaware and Chester Counties towards Maryland, swings around southward in a curve towards Chester, on the Delaware, not in an unbroken line, but in a series of projections, like the teeth on a circular saw, some of which reach Chester Creek."

Without a map of these outcrops the precise meaning is not clear, but if a line be drawn upon the map,[1] connecting the Schuylkill soapstone quarries with the westernmost outcrop on the Black Rock road, and be produced southwestwardly to Chester Creek, the outcrop on Meadow Brook will be found three-quarters of a mile northwest of this line; that on Darby Creek, one mile northwest; that on the West Chester road, one-half mile northwest; that on the road from Newtown Square to Palmer's Mills, upon it, or very little northwest; that at Blue Hill, upon it; that on Dismal Run, thirteen miles from the Schuylkill, a quarter of a mile southeast; that at Lenni on Chester Creek, about a mile southeast.

If, in like manner, we produce a line passing through the Lafayette belt, from the Schuylkill to Rosemont, the Meadow Brook outcrop will be found upon it; that on Darby Creek, quarter of a mile northwest; West Chester road, less than a quarter of a mile southeast; Palmer's Mills, one mile southeast; Blue Hill, one mile southeast; Dismal Run, $1\frac{1}{4}$ miles southeast; Lenni, about two miles southeast.

Page 12, we find, "The primal * * * is not recognizable west of the Schuylkill river, south of the south edge of the auroral limestones of the valley in the South Valley Hill."

Page 32, "West of the Montgomery County line, near the southern margin of this group" (the South Valley Hill schists), "we find garnetiferous mica schists."

Page 36, "West of West Conshohocken the Potsdam does not exist, and the limestone rests directly upon the Laurentian;" but we find no mention of the sandstone and beds of sand, resulting from its decomposition, flanking the Chester Valley on the south, described by Prof. H. C. Lewis, in the Proceedings of the Mineralogical Section of the Acad. Nat. Sci., No. 1, page 93.

[1] I have used map of Delaware County, by G. M. Hopkins & Co., of Philadelphia, 1876, which I believe to be the most accurate map of the County.

West of West Conshohocken, a rock wholly indistinguishable from the eurite of Barren Hill, which Mr. Hall considers proved. to be Potsdam, *does* occur at several (at least three) localities, viz.: southeast of Mechanicsville, in Radnor just west of the county line, and at Wayne, P. R. R.

That the limestone rests directly upon the Laurentian is more than doubtful, for while they cannot be observed between the two adjacent outcrops near the river, yet if the lines of the two be prolonged, mica schists, garnetiferous mica schists, and the peculiar thin-bedded feldspathic gneiss with crystals of hornblende found south of the syenite between the serpentine and steatite, can be seen, having a breadth of probably over three hundred feet, within a thousand westward of the limestone exposure.

There are three facts tending to prove that Cream Valley on the south side of the South Valley Hill is, though very narrow, similar in structure to the Chester Valley :

I. The presence of limestone.
II. The existence of iron ores resembling those of the Potsdam.
III. The presence of eurite.

On page 27 the Manayunk mica schists and gneisses are stated to extend from the vicinity of Haddington on the south to Ardmore on the north.

There is no mention made of the porphyritic gneiss which begins eastwardly as a narrow belt at the Falls of Schuylkill, this rock by its superior hardness causing the "falls." It widens out westwardly until at the Pennsylvania Railroad it attains a width exceeding a mile, and occupies fully one-half the limits above quoted. It extends southward to Market Street; south of this I have not examined. It is too important a belt, not only in its extent, but also in its uniformity throughout its whole limits, to be ignored in a study of the region. The same may be said of the Frankford gneiss which appears to extend as a distinct and characteristic belt, but with a strike much more east and west than the other rocks, from Frankford to the Wissahickon.

That the syenite belt south of the South Valley Hill is an anticlinal seems beyond question. Now both on the north and south of it occur thin-bedded micaceous gneiss and hornblendic gneiss, succeeded by garnetiferous mica schist. In the syenite, or very close to it in the micaceous gneiss, both on the north and south occur beds of serpentine of almost identical appearance, and in

the mica schists, steatite, talc and serpentine very similar in character on both sides of the anticlinal. So nearly vertical are all the dips that no very cogent argument can be derived from them.

North of the schists is eurite, almost undoubtedly Potsdam sandstone, then altered schists, limestone, trap, and then the South Valley Hill.

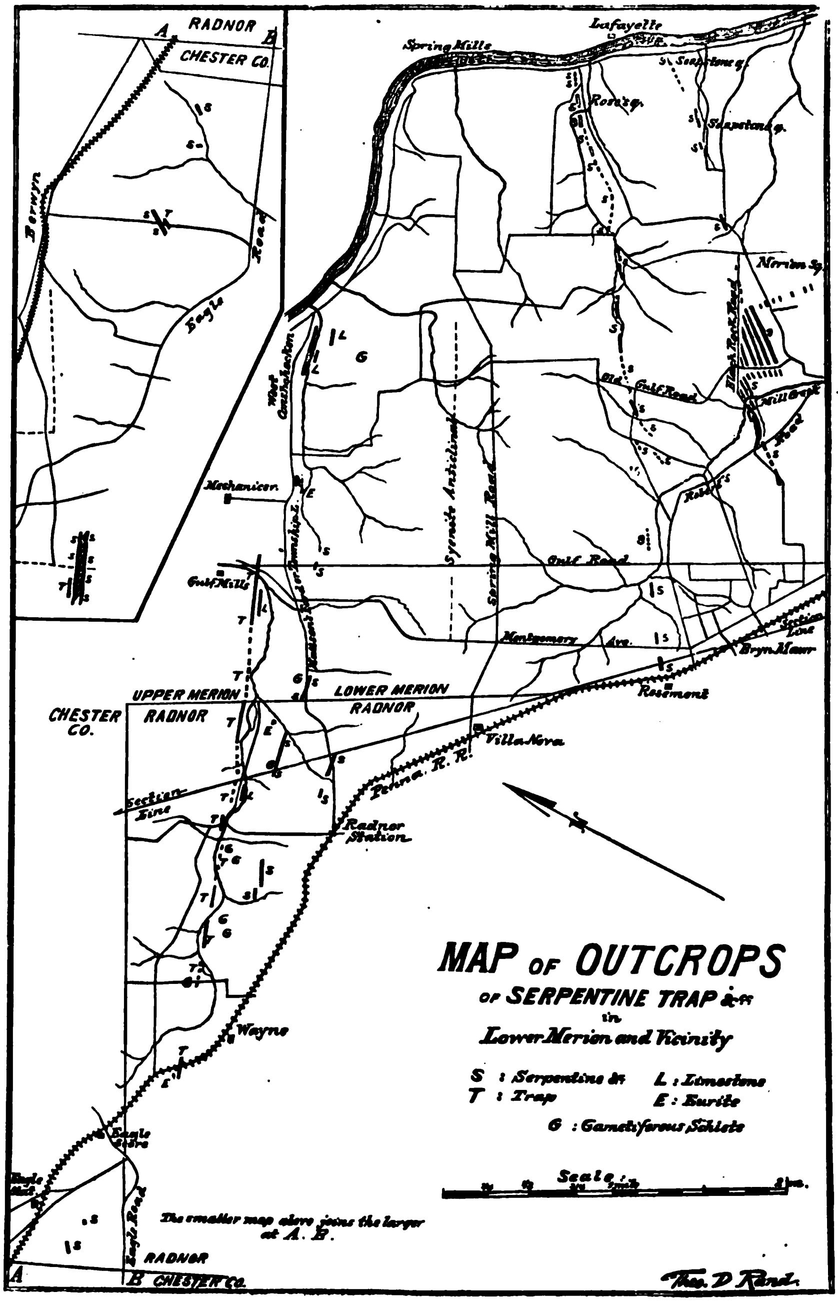
My view of a section along a line from Bryn Mawr northwest to a point in the north line of Radnor Township, Delaware County, about a half mile west of the east line, that is west of Mr. Hall's line H, and bearing a few degrees more northeast and southwest in order to connect one of the limestone outcrops in Cream Valley with the Rosemont serpentine outcrop, is given herewith. Outcrops of all the rocks are exposed within little over a half mile of this line, and all save the eurite, and the southern steatite belt, almost or quite upon it, though the characters of the rocks can in some cases be better studied in more distant outcrops, of undoubtedly identical rocks.

1. Syenite.

	NORTHWARD.		SOUTHWARD.
			Thin bedded micaceous gneiss.
2.	Serpentine.	2′.	Serpentine.
3.	Thin-bedded gneiss. Micaceous gneiss. Feldspathic gneiss with crystals of hornblende. Hornblendic gneiss.	3′.	Mica schist and thin-bedded gneiss with crystals of hornblende. Hornblendic gneiss.
4.	Steatite with serpentine.	4′.	Steatite with serpentine.
5.	Mica schists and garnetiferous mica schists.	5′.	Garnetiferous mica schists.
	Eurite.		
	Schistose gneiss.		
	Limestone.		
	Schistose gneiss.		
	Trap.		
	South Valley Hill hydromica schists.		

Now if this succession occurs, if of 2 and 2′, 4 and 4′, each most closely resembles the other, and 3 and 3′, 5 and 5′, are not unlike, is it not strong evidence that the structure is a simple anticlinal?

I submit herewith a map of the region showing most of the outcrops mentioned.


MAP OF OUTCROPS
OF SERPENTINE TRAP &c.
in
Lower Merion and Vicinity
S : Serpentine &c.
T : Trap
L : Limestone
E : Eurite
G : Garnetiferous Schists
Scale
RADNOR
CHESTER CO.
Berwyn
Eagle Road
Lafayette
Spring Mills
Mechanicsv.
Gulf Mills
Gulf Road
Old Gulf Road
Spring Mill Road
Syenite Anticlinal
Montgomery Ave.
UPPER MERION
LOWER MERION
RADNOR
CHESTER CO.
Villa Nova
Penna. R.R.
Radnor Station
Rosemont
Bryn Mawr
Section Line
Wayne
Eagle Store
Eagle Road
The smaller map above joins the larger at A. B.
Thos. D. Rand.

On Phytocollite, a New Mineral.—Prof. LEWIS reported that, having made a further examination of the black jelly-like substance from the Scranton peat-bog, to which he had drawn attention at the September meeting, he had found that it had characters differing from those of any other mineral heretofore described. By dissolving it in a standard solution of alkali he had found that it had an acid reaction, and was, therefore, to be regarded as an organic acid. It is probably related to some of the varying forms of humic acid.

The following analysis, kindly made by Mr. J. M. Stinson, of Harrisburg, was made upon material which was carefully separated from the surrounding earthy matter, and which, before analysis, was dried at a heat of 212° F.

C	28.989		C	30.971
H	5.172		H	5.526
N	2.456	or without ash,	O + N	63.503
O	56.983			
Ash	6.400			100.
	100.			

This analysis would yield the empirical formula $C_{10}H_{22}O_{16}$.

In its composition, this substance is remarkable for the low percentage of carbon which it contains.

It differs from dopplerite principally in its composition (dopplerite having the formula $C_{1..}H_{10}O_{10}$), and also by its partial solubility in alcohol and its burning with flame.

Instead, however, of giving this mineral a specific name, it is now suggested to group together, under one generic name, all those jelly-like substances produced by vegetable decomposition which are found in nature.

The name *Phytocollite* (φυτων κόλλα), signifying *plant-jelly*, would include the mineral from Scranton, the dopplerite of Austria and Switzerland, the jelly-like mineral from Finckenbach, St. Gall, which Deicke describes as burning with a bright flame, and all similar minerals of like origin. Each of the above minerals would, therefore, be classified as varieties of phytocollite.

FEBRUARY 7.

The President, Dr. LEIDY, in the chair.

Twenty-two persons present.

Filaria of the Black Bass.—Prof. LEIDY stated that he had been told that the black bass, *Micropterus nigricans*, in some localities is much infested with a red thread worm. One procured in market a few days since for his table, was found to be greatly infested. The worms were coiled in oval masses from the size of a pea to that of a large bean, and were situated beneath the skin, in the muscles and under the membrane lining the abdomen. The worm is cylindrical, slightly narrowed and obtusely rounded at both ends, minutely annulate and otherwise smooth, pale red, bright red, or brownish red, translucent, with the darker red, or brownish intestine and the white œsophagus shining through. Mouth a small pore, unarmed; anus a transverse elliptical pore, terminal. Œsophagus long, capacious, cylindrical, straight or somewhat tortuous, slightly expanded below where it is constricted from the intestine, which is likewise expanded at the commencement, and ends in a short, more translucent rectum. Ovarium and ova indistinctly seen. Length from 3 to 6 inches by half a line in diameter.

The worm appears to be a Filaria, but the determination of the species was left for more extended observation.

FEBRUARY 14.

Mr. MEEHAN, Vice-President, in the chair.

Twenty-six persons present.

Sponges from the neighborhood of Boston.—Mr. E. POTTS exhibited some fragments of fresh-water sponges collected in the Cochituate Aqueduct and sent to him by the Superintendent of the Boston Water Works. Alluding to the deleterious effects recently attributed to this sponge, as the cause of the pollution of the Boston water-supply, he said he was not prepared either to affirm or deny it. While he was well aware that a decaying fresh-water sponge was one of the foulest things in nature, in his own experience he had never met with it in sufficient quantities, locally, to suppose it capable of tainting, in its decay, millions of gallons of water, as now represented.

An examination of the sponge as to its specific relations, revealed some peculiar facts. Primarily it was evident that the sponge was

much "mixed"; the presence of two or more species being very apparent.

One of these, with long branching finger-like processes, smooth skeleton spiculæ, no appearance of dermal or flesh spiculæ, while the abundant *smooth* statospheres retained few if any acerate spicules, bore a sufficiently close resemblance to the description of *Spongilla paupercula* as given by Dr. Bowerbank from specimens collected in the same or a neighboring locality before 1863.

With this form was found another, probably altogether sessile, consisting of an intertexture of stout fusiform acerate skeleton spicules, abruptly pointed, coarsely spined, except near the extremities, spines subconical, acute; dermal spicules absent or undiscovered; statospheres without granular coating, some of them exhibiting a few misplaced, irregular, or malformed birotulate spicules, the distinguishing feature of which is the prolongation of the familiar boss upon the outer surface of each rotule into a long acuminate spine, in line with, and a continuation of the shaft. He suggested for this species, provisionally, the name *Meyenia acuminata*.

The exceptional features referred to above, as marking this collection of sponges were: *First*, the fact that all the statospheres, whether belonging to the genus *Spongilla* or *Meyenia*, were *smooth*, that is without a granular or cellular "crust;" *second*, the apparent absence of dermal spicules in both and the abnormal character of those belonging to the statospheres. The appearance is not infrequent, but has, so far as known, heretofore been limited to the genus *Spongilla*. The recurrence of the same feature in the associated genus *Meyenia*, coupled with the fact that many of the birotulates upon its statospheres, were imperfect, the rays being more or less aborted, approximating their shape to that of the spined fusiform acerates of *Spongilla*, gave rise to the suggestion that here, possibly, had been, not merely a mechanical mixture by inter- or super-position of species, but an organic hybridization produced by the flowing together of the amœboid particles of which the sponges are composed, or even by a fertilization of the ova of one by the spermatozoids of the other.

Several facts indicative of the probability that such hybridization may take place were adduced, and the further discussion of the subject deferred until an examination of the living sponge in its native locality, or experiments upon those germinated in confinement, could be made.

It is important to notice that the specimens received were collected in February, when the sarcode matter had nearly all been washed away, with, probably, accompanying changes in the presence or numbers of the smaller spiculæ.

FEBRUARY 21.

The President, Dr. LEIDY, in the chair.

Twenty-five persons present.

The deaths of John W. Draper and Theo. Schwann, correspondents, were announced.

The death of Robert Bridges, M. D., having been announced, Dr. W. S. W. Ruschenberger was appointed to prepare a biographical notice for publication in the Proceedings.

FEBRUARY 28.

The President, Dr. LEIDY, in the chair.

Thirty persons present.

On Tourmalines.—Prof. LEIDY said, in absence of other matters of more importance, he would exhibit a collection of tourmalines which belonged to him, and which he thought from their variety would interest the members. He remarked that while black tourmalines are the most common, white ones are rarest. Recently, good-sized crystals of the latter had been found at De Kalb, St. Lawrence Co., New York. From a broken crystal he had obtained a fragment, from which the beautiful gem presented was cut. This is of brilliant form, highly lustrous, transparent, flawless, and nearly colorless, or with only the faintest yellowish tint, like that of a so-called "off-color" diamond; and weighs 398 millegrammes. Some remarkable black tourmalines were brought to this city, a couple of years ago, by Lieut. Wm. A. Mintzer, U. S. N., who obtained them at Niantilik, Cumberland Gulf, Arctic America. They are generally three- or six-sided crystals, with a single three- or six-sided pyramidal termination, of various sizes. A large one in Prof. Leidy's possession is thirteen inches long and one and three-quarter inches at the pyramidal extremity. Perhaps the most beautiful black tourmalines, recently discovered in abundance, are those of Pierrepont, St. Lawrence Co., N. Y. They are remarkable for their perfection; occurring as doubly-terminated crystals, of large size and brilliant lustre. Fine brown tourmalines, often of large size and frequently doubly terminated, with one extremity much modified from the usual form, have also been found in abundance in late years, at Gouverneur, St. Lawrence Co., N. Y. It may be said that this State is pre-eminent for the beauty of its black, white, and brown tourmalines.

The chief localities for colored tourmalines, other than the varieties mentioned, are the Urals, Ceylon, Elba, Brazil and Maine. Of the collection, those from the latter two localities most resemble one another; crystals of the same ordinary tourmaline green color, others of a green color and garnet red-axis, and some with different parts of the prism colored pink and green, of varied depth. The pink is sometimes as delicate as that usual in Elba tourmalines, and sometimes as deep and bright as that of the deepest-hued pink topazes of Brazil. The Maine tourmalines exhibit a wonderful variety of shades of green and red, ranging from the darkest hues to the transparent colorless variety called achroite. The largest and finest achroites seen by Prof. Leidy, have been derived from the Mt. Mica locality.

Among the Maine tourmalines in the collection, chiefly obtained through Dr. A. C. Hamlin, of Bangor, the following were especially indicated:

1. A three-sided prismatic crystal with one end flat, the other a trilateral pyramid, four inches long, and ten lines wide. One half towards the pyramidal end is green, dark and nearly opaque at first, but becoming transparent apple-green; the other half is green on the exterior, but has a garnet-red axis towards the flat end, passing into pale pink towards the middle of the crystal. The specimen is broken into five fragments, a condition quite common in the larger Maine tourmalines, and supposed to be due to the action of frosts. 2. Two fragments of a crystal, an inch and a half in diameter, of a bright, rose-topaz color, becoming nearly colorless and then ending in an apple-green plate, forming a flat termination of the crystal. 3. A fragment of a three-sided crystal, an inch long and an inch and a half wide, consisting of transparent achroite, with one end covered with Cookeite. 4. A dark green three-sided crystal with trilateral pyramid, an inch and a quarter long, and three-fourths of an inch in diameter. The base was occupied with a spherical nodule of achroite, from which was cut a beautiful gem, of brilliant form, flawless, perfectly transparent, and weighing 400 millegrammes. It is nearly colorless, but has a faint pinkish hue.

Among the Brazilian tourmalines were the following:

1. A large, three-sided crystal, with pyramidal termination, rich tourmaline-green, transparent and flawless. It was originally two inches and a half long, and is eight lines wide. From its base a fine brilliant was cut, weighing 5980 millegrammes. 2. Two small green crystals with pyramidal termination, one pale red at the terminal end; the other of the same color at the base. 3. Two large six-sided crystals with flat termination, green externally, with garnet-red axis. One an inch and a half long, and three-fourths of an inch thick; the other an inch and a quarter long, and an inch thick. 4. A rubellite of garnet-red color; a three-sided crystal with pyramidal termination, an inch long, and seven-eighths broad.

Brilliant cut specimens of rose-red tourmaline from Maine and Brazil were alike in color. An Elba tourmaline about an inch in length was six-sided with a three-sided pyramid. The base is yellowish green; the upper extremity pale pink. A Ural rubellite, garnet-red, was six-sided with a six-sided pyramid.

Frank E. P. Lynde was elected a member.

Robert Hartmann, of Berlin; W. Kowalewsky, of Moscow, and K. Martin, of Leiden, were elected correspondents.

The following was ordered to be printed:—

THE SPECIES OF ODONTOMYIA FOUND IN THE UNITED STATES.

BY DR. L. T. DAY.

In this paper I have confined myself exclusively to the description of the species found in the United States.

O. limbipennis Macq. I have left out entirely, for the following reason: on page 255 of Baron Osten Sacken's valuable catalogue of N. A. Diptera, note 57, he says: "The label in Macquart's handwriting in Mr. Bigot's collection bears *America*, with a query; the query is omitted in the Dipt. Exot. I doubt that this is a North American species." Of the Canadian species *O.* (*Stratiomys*) *canadensis* Walk., and *O. inequalis* Loew, Hudson Bay Ter., only the latter has been identified; probably the former never will be. Of the Mexican species none have been identified. Of the Cuban, *O. rufipes* and *O. scalaris* Loew are marked as being identified. Olivier, in the Encycl. Method, viii, gives the following generic characters, which I insert in the original, as they may be of service to some:

Antennes à peine de la longueur de la tête, filiformes, termineès en pointe; articles courts, presqu'égaux.

Trompe courte; gaine recourbée sendue et renflée a son extremité.

Trois soies inégales; lévre supérieure courte, échancrée.

Antennules courtes, biarticulées, en masse.

Ailes avec une cellule centrale, petite, polygone.

In the following table I have included only those species which are new, and those identified in my collection. Those species of Loew not in the table, and of Say, Walker, Wiedemann and Olivier, I have inserted at the end of the descriptions represented in the table.

Synopsis of Species.

	Head black, ...	A.
	Head with yellow or green markings, ...	F.
A.	Dorsum of thorax pubescent, ...	B.
	Dorsum of thorax pilose, ...	C.
B.	Face with an eminence below the base of the antennæ,	*nigra*, sp. n.
	Face gently arched without eminence. .	*plebeja* Loew.

C. Face of male small, ... *flava* sp. n.
Face of male of usual size, ... D.
D. Femora black, ... *pilosus* sp. n.
Femora not black, ... E.
E. Second joint of antennæ shorter than the first, *pubescens*, sp. n.
Second joint as long or longer than first, *americana*, sp. n.
F. Dorsum of thorax with lateral stripes, . . . H.
Dorsum with spots on the posterior angles, . . G.
G. Color markings luteous, ... *microstoma* Loew.
Color markings greenish, ... *bicolor* sp. n.
H. Face with distinct black spots, . . . *Willistoni* sp. n.
Face without black spots, ... I.
I. Dorsum of thorax with two spots on the suture, *megacephala* Loew.
Dorsum of thorax without spots on the suture, *extremis* sp. n.

Odontomyia nigra sp. n. ♀

Black. Head black. Occipital disk black. Front shining black, in the central groove a stripe of a golden hue. Antennæ ferruginous red, the first two joints of nearly equal size, the third longer than both and tipped with brown or black. Face prominent, black, and sparsely pubescent with golden pile; a well-defined eminence is situated beneath the antennæ. Oral aperture small, proboscis black, so also labii and palpi. Thorax black, covered with golden pubescence. Scutellum concolorous, also clothed with the pile, the terminal bristles brownish yellow. Halteres green. Abdomen dark yellow; the median stripe black and forms a triangular spot in each segment, the base anterior. Venter brownish yellow. Legs luteous. Wings hyaline; third longitudinal vein simple; the discal cell emits two veins.

Long. corp. 4 lin., long. al. 3 lin.

Hab.—Kansas (E. W. Guild).

NOTE.—In one of the specimens the abdomen is black, with a feeble attempt at markings near the incisures by way of golden pile; the antennæ are black, and the terminal joints of the middle and posterior tarsi.

Odontomyia plebeja Loew. ♂ ♀.

♂. Black; the whole head concolorous; face not prominent, gently arched and clothed with golden yellow pile. Antennæ reddish at the base, the terminal joint being black. Thorax black

and clothed with golden yellow pubescence. Scutellum concolorous, the apical spines yellowish. Halteres green. Abdomen green, with a black irregular stripe, extending almost to the posterior margin of the fifth segment. Venter green, immaculate; legs wholly yellow. Wings hyaline, the veins yellow, the third longitudinal simple, the discal cell emits two veins.

♀. Front black with irregular spots of subaureous tomentose. Face and thorax clothed with subaureous tomentose in place of the golden yellow pile in the male.

Long. corp. $3\frac{1}{2}$ lin., long. al. 3 lin.

Hab.—Kansas (Guild); Mass. (Williston); Conn. (Norton).

Odontomyia flava sp. n. ♂

Black; head concolorous, antennæ black. Face small, black, clothed with yellowish pile; borders of the mouth slightly reddish. Thorax black, clothed with golden pile. Scutellum black, the terminal spines concolorous. Halteres yellow. Abdomen yellow, with black median stripe, the yellow running in at the incisures, thus forming connected quadrangular black spots in the segments. Venter yellow, immaculate; legs yellowish; femora brown; tarsi black; anterior and middle tibiæ with a solitary brownish ring. Wings hyaline, veins yellow, third longitudinal simple, the discal cell emits three veins, the posterior being rudimentary.

Long. corp. $5\frac{1}{2}$ lin., long. al. 4 lin.

Hab.—Wyoming (Dr. Williston).

NOTE.—This is described from a single specimen, and the rudimentary vein emitted from the discal cell may not hold as a good character for distinguishing species.

Odontomyia pilosus sp. n. ♂

Black. The whole head concolorous. Antennæ black. The face prominent and thickly clothed with long yellowish pile. Thorax and scutellum black and also thickly clothed with the long yellowish pile, the terminal spines of the scutellum yellow. Halteres yellow. Abdomen black, and sparsely clothed with the yellowish pile, laterally are triangular yellow spots running in transversely at the incisures. Venter yellow, with small brown spots in the median line, situated in the middle of each segment. Legs blackish; femora black, the under side covered with a thick growth of yellow hair; the distal half of all the tibiæ black, the proximal portion being yellow; tips of tarsi black. Wings hya-

line, the veins reddish brown, third longitudinal simple, the discal cell emits two veins.

Long. corp. 6 lin., long. al. 4½ lin.

Hab.—California (Baron).

Odontomyia pubescens sp. n. ♂ ♀

♀. Black. The whole head concolorous. Front sparsely golden pubescent. Antennæ black, the first joint longer than the second. Face prominent and covered with golden pubescence. Proboscis black. Thorax black, with golden pubescence. Scutellum black, also pubescent, the apical spines yellow. Halteres green. Abdomen black, with lateral transverse yellow stripes at the incisures. Venter yellow with irregular brownish spots. Legs brownish yellow. Wings hyaline, veins brownish yellow, third longitudinal vein simple, the discal cell emits two veins.

Long. corp. 4½ lin., long. al. 4 lin.

Hab.—New York (Dr. Williston).

♂. Black. The face covered with a thick yellowish pile, as also the thorax; the apical spines of the scutellum yellow. Halteres yellow. The yellow spots at the incisures of the abdomen more prominent than in the female. Legs yellowish brown, femora tipped with black.

Hab.—California (Baron); New York.

NOTE.- In one of the male specimens the halteres are green, in another from the same locality yellow. I do not consider the change of color of any value; in the living specimens they were probably green.

Odontomyia americana sp. n. ♂.

Black. Head black. Antennæ reddish brown, the second joint as long or longer than the first. Face small, not prominent. Proboscis black. Thorax black and covered with a yellowish white pubescence. Scutellum the same, the apical spines being yellow. Halteres green. Abdomen green, with a median black stripe of nearly equal breadth throughout. Venter green, immaculate. Legs yellow. Wings hyaline, veins yellow, the third longitudinal simple, the discoidal cell emitting two veins.

Long. corp. 4 lin., long. al. 3 lin.

Hab.—Cal. (Baron).

Odontomyia microstoma Loew. ♀.

Black-yellow. Head yellow; occiput yellow. Front widens slightly anteriorly, about the centre or on either side is situated a

brownish spot, anterior to this it is clear, posterior sparsely mottled; ocellar triangle black, and on each side is a brownish spot. Antennæ brownish black; the first two joints cylindrical, brownish; the terminal end of the second darker; the third black, tapering to a point. Face not prominent, moderately convex and clothed with dilute yellow pile. Oral aperture small; proboscis black; labii brownish; palpi yellow.

Dorsum of thorax black, subaureous pubescent, posterior angles yellowish. Scutellum yellow, the apical spines tipped with black. Abdomen brownish yellow, the central black stripe is interrupted by median yellowish spots. Venter dilutely yellow, laterally with two dark stripes. Legs dark yellow; posterior tarsi obscurely brown. Wings hyaline, veins yellowish, third longitudinal simple; the discoidal cell emits two veins.

Long. corp. 5 lin., long. al. 4 lin.

Hab.—Mass., N. Y. (Dr. Williston).

NOTE.—"The last two segments of the third joint of the antennæ in this species form a sufficiently acute style, as may be shown; the antennæ of this are not dissimilar to those of *Clitellaria*, but the downward course of the veins in this species demonstrates its place in the Odontomyiæ."—LOEW.

Odontomyia bicolor sp. n. ♂.

Black-green. Head large, yellowish green. Occiput yellowish green. Antennæ reddish brown, the terminal segment of the third joint tipped with black. Face prominent, green, sparsely pubescent with yellow. Proboscis brownish black. Thorax black, the posterior angles yellow, the lateral borders clothed with yellow pile. Pleuræ green and clothed with yellow pile. Base of scutellum black, bordered with yellow; the apical spines yellow, tipped with black. Halteres green. Abdomen green, with a median black irregular stripe. Venter green, immaculate. Legs reddish, the femora being yellowish towards the body, the tarsi black. Wings hyaline, veins brownish, the third longitudinal simple; the discal cell emits three veins.

Long. corp. 6 lin., long. al. $4\frac{1}{2}$ lin.

Hab—Cal. (Baron).

Odontomyia Willistoni sp. n. ♀.

Green. Head and occiput green. Front broad, green, with two brownish spots on each side near the orbit, also a central brown spot just anterior to the ocellar triangle. Antennæ black. Face greenish, prominent, with an irregular black spot on each

side extending from the base of the antennæ downward. Proboscis black. Thorax black, sparsely pubescent, bordered laterally with yellowish green, extending to the posterior angles. Pleuræ yellowish green, with a central narrow black stripe extending to beneath the halteres. Scutellum green, apical spines yellowish. Halteres green. Abdomen green, with a central black irregular stripe, which terminates in the middle of the last segment. Legs yellowish, concolorous. Wings hyaline, veins yellow, the third longitudinal simple; the discal cell emits three veins.

Long. corp. 4 lin., long. al. 3 lin.

Hab.—New York (Dr. Williston).

The above species is respectfully dedicated to Dr. S. W. Williston, to whom I am greatly indebted for the use of his extensive collections in the preparation of this paper.

Odontomyia megacephala Loew. ♂ ♀

♂. Black-green. Head and occiput yellowish green; the head very large. Antennæ reddish, the terminal joint being almost black. Face yellowish green, immaculate, not prominent, receding towards the oral aperture. Proboscis black. Thorax black, pubescent with yellow, the lateral borders and posterior angles green; there is also a greenish spot on each side of the thorax near the median line crossing the transverse suture. Pleuræ green, clothed with yellowish pile. Scutellum yellowish green; the apical spines yellow, tipped with black. Halteres green. Abdomen green, with a black median stripe; the posterior half of the terminal segment green. Venter wholly green. Legs reddish; the anterior and middle tibiæ markedly tipped with black, the posterior obscurely so; all the tarsi tipped with black. Wings hyaline; veins yellow; third longitudinal simple; the discoidal cell emits three valid veins.

Long. corp. 5½ lin.; long. al. 4 lin.

♀. Green. Head and occiput green. Front green, widening anteriorly with two well-marked transverse black stripes, the superior being the broader, extending from orbit to orbit just beneath the ocellar triangle; the lower extends irregularly transverse across the whole front a short distance above the base of the antennæ. Antennæ reddish brown, the third joint tipped with black.

Long. corp. 7 lin., long. al. 5 lin.

Hab.—Kansas (Guild); Cal. (Baron).

Odontomyia extremis sp. n. ♀ ♂

♀. Green-black. Head and occiput green. Front green; on each side, midway between the ocellar triangle and the base of the antennæ, is a large round black spot. Antennæ brownish; the terminal segments of the third joint black. Face green, prominent, pubescent with yellow. Thorax black, subaureous tomentose, bordered laterally with green, extending to the posterior angles. Scutellum green; the apical spines yellow. Halteres green. Abdomen green, with a central black stripe widening posteriorly; at the incisures the black extends quite to the lateral borders. Legs brownish yellow; tarsi blackish. Wings hyaline; veins yellow; the third longitudinal simple; the discal cell emits three veins.

♂. The only difference from the females is that the males possess a black occiput.

Long corp. 6 lin., long. al. 4½ lin.

Hab.—Conn.; Cal. (Baron).

NOTE.—Related to *O. cincta*, but differing in the abdominal markings quite strongly.

Odontomyia arcuata Loew. ♀ Cent. x, 4.

Greenish yellow; occiput except orbit, vertex, unequal band of the front, base of antennæ, dorsum of thorax and abdomen black; lateral spots in the median line of the abdomen almost united, and venter wholly yellow. Legs luteous; two submarginal cells; four posterior.

Long. corp. 5⅓ lin., long. al. 4¼–4⅓ lin.

Head pale yellow. Face obtuse, immaculate. Occiput, except the orbit, black. Superior third of the front black; in posterior margin two obsolete luteous dots; in front the unequal black band is seen, composed of two large spots running into the sides. Antennæ black; base reddish brown. Dorsum of thorax, except the humeri and posterior angles, black, aureous tomentose, toward the borders thickly clothed. Scutellum yellow; base black; apical teeth small, subapproximate, toward the apex black. Pleuræ wholly immaculate, greenish yellow, in life without doubt green. Abdomen black; second, third and fourth segments each with a single yellow triangular spot; or greenish yellow, concave anteriorly, and the acute angle extending nearly to the middle of the abdomen; posterior and lateral margins of the fifth segment yellow, yet the transverse smearing black and more pronounced; sixth segment yellow. Venter wholly yellowish green or green,

immaculate. Legs luteous; tarsi, from the apex of the first joint, brownish black. Wings pure hyaline; veins strongly ochreous; third longitudinal with branch; discal cell emits two veins.

Hab.—California (H. Edwards).

Odontomyia binotata Loew. ♂ Cent. vi, 22.

Green. Dorsum of the thorax, except the lateral borders and two disks, punctate; metanotum and abdominal stripes black; only one submarginal cell, five posterior.

Long. corp. $5\frac{1}{2}$ lin, long. al. $4\frac{1}{2}$ lin.

Vertical triangle black; base green; frontal triangle minute, black. First two joints of the antennæ cylindrical, subequal, of ferruginous red. Face totally green, not prominent, toward the oral aperture strongly receding. Keel moderately convex and obtuse. Proboscis pale; palpi concolorous, labelli black. Dorsum of thorax black; two small spots and lateral borders green. Pleuræ green; breast grayish black. Scutellum totally green; metanotum black. Abdomen green; the stripe towards the base of the first segment strongly dilated, in the second and third segments profoundly emarginated, and the two points in the angle of the fourth segment black. Venter wholly green. Legs ferruginous red; the first half of the femora and base of the tibiæ yellow; the apex of the anterior femora, the apex of the anterior tibiæ and all the tarsi black, but the posterior metatarsus except the apex and base of the anterior, ferruginous red. Wings purely hyaline; veins strongly ochreous; third longitudinal without branch; the discal cell emits three equal veins.

Hab.—Illinois (Le Baron).

Odontomyia lasiophthalma Loew. ♂. Cent. vi, 23.

Black, varied green, eyes strongly pilose, second joint of the antennæ half as short as the first. Legs luteous, femora except the apex black, one submarginal cell of the wings, five posterior.

Long. corp. $4\frac{1}{6}$ lin., long. al. $3\frac{1}{3}$ lin.

Head black; face concolorous, shortly conical, two transverse spots constituting narrowly interrupted bands, and two lesser at the anterior margin of the eye pale yellow. Eyes clothed with compact long hair. First two joints of the antennæ dark yellow, toward the apex obscure, the second one-half, and the last longer than the first; the third joint is wanting in this specimen. Dorsum of thorax with rough sub-luteous black hair, posterior angle yellowish green. Pleuræ concolorous, whitish hair, two spots of

a yellowish green, the larger ones of a broken angular form, the smaller oblong ovate. Scutellum black, narrowly bordered with yellowish green. Abdomen black, the whole margin and spots both a third part green, in the second segment a spot large and triangular, not reaching to the anterior margin: the third moderate and transverse, the fourth narrow. Venter wholly green. Legs luteous or luteo-ochreous, femora except the apex black. Wings hyaline, veins thickly ochreous, third longitudinal without a branch, the discal cell emits three equal veins.

Hab.—New York; New Jersey.

NOTE.—This species on account of the first joint of the antennæ being longer than the second strongly distinguishes between Stratiomyiæ and Odontomyiæ, and as it were intermediate on account of the simple straight third longitudinal vein refers this genus to the Odontomyia rather than Stratiomyiæ.

Odontom is n gerrima Loew. ♀ Cent. x, 6.

Black, bare, scutellum toothed, apex of femora and tibiæ, and base of tibiæ and tarsi testaceous; second abdominal segment, third and fourth posterior margins near the border and all of the fifth lutescent; face protuberant, extraordinarily prominent, first joint of the antennæ longer than the second, veins of the wings strongly fuscous, four posterior cells and two submarginal.

Long. corp. 4 lin., long. al. 3½ lin.

Black, shining, bare, whitish, short pubescent. Head concolorous, longitudinal fossa of the front and both margins testaceous. Face extraordinarily prominent, protuberant, obtuse, lateral margins of the mouth strongly dilated. Proboscis black, stock drawn out, head long and very thick. Antennæ drawn out, black, first joint once and a-half as long as the second. Scutellum wholly black, teeth fusco-testaceous. Posterior margins of the second abdominal segment, third and fourth toward the side of the abdomen of a lutescent color, thus three narrow bands are seen, broadly interrupted; the posterior margin of the fifth segment wholly lutescent. Venter black, a broad disk unequal and darkly lutescent. This abdominal picture in living specimens I suspect to be wholly green. Legs black, apex of the femora, base and apex of the tibiæ and first and last joints of the tarsi except the apex fusco-luteo-testaceous. Wings hyaline, veins strongly brownish black, costal and third longitudinal subfuscous toward the apex, third longitudinal vein with erect branch, discoidal cell emits two veins.

Middle States.

Odontomyia nigrirostris Loew. ♂. Cent. vi, 19.

Black and yellow varied, scutellum without teeth, two submarginal cells, five posterior.

Long. corp. $5\frac{2}{3}$ lin., long. al. $4\frac{3}{4}$ lin.

Black and yellow varied, clothed with pale pubescence. Head yellow; lateral frontal stripes black, broad, abbreviated anteriorly, posteriorly with a black spot cohering with the vertex; a large black spot on the face. Antennæ black, first joint a little longer than the second. Proboscis wholly black, palpi concolorous. Dorsum of thorax black, margin of the posterior angles pale yellow. Pleuræ pale yellow, black maculated; breast black. Scutellum shortened, pale yellow, toward the base black. Abdomen broad, subplanum, black, from the angle of the first segment, a spot extends laterally from the anterior to the posterior margins, narrow in the third and fourth margins posteriorly and in the abdominal margin, all pale yellow. Venter wholly pale. Legs black, apex of all the femora, first half of anterior tibiæ and base of anterior and posterior tarsi dilute yellow or whitish. Wings pure hyaline, veins strongly ochreous, third longitudinal with branch, thus is made two marginal cells; discal cell emits three veins of which the one preceding the last is much shorter.

Hab.—North Wisconsin (Kennicot).

NOTE.—The number of posterior cells in distinguishing *Odontomyia* causes note, which is greatly relied upon; less is determined by making out the number of submarginal cells, in those species where there is only one submarginal cell, which does not happen rarely, as the third vein may be with a branch; or where two submarginal cells are found, this branch may be wanting.

Odontomyia pilimana Loew. ♂ ♀ Cent. vi, 27.

Black, antennæ red, dorsum of thorax in both sexes aureous tomentose, abdomen green, median stripe black, legs luteous, anterior and posterior tibiæ and metatarsus hairy beneath; four posterior cells, one submarginal.

♂. Thoracic pile shorter than in known species.

♀. Front near the ocelli luteous bipunctate.

Long. corp. $4-4\frac{7}{12}$ lin., long. al. $3\frac{1}{12}-3\frac{5}{12}$ lin.

♂. Head black, face scattered with white hair, obtuse bicarinate, below the antennæ prominent, toward the oral aperture receding. Antennæ red, apex of third joint black. Proboscis thick, black. Thorax wholly black; dorsum more lutescent, thin in real male species and clothed with short aureous tomentose; pleuræ white

pilose. Scutellum black, teeth and apical margin greenish. Abdomen green, black median stripe, moderately dilated posteriorly. Legs wholly luteous; anterior and posterior tibiæ and metatarsus clothed beneath with long pallid pile. Wings hyaline, veins strongly lutescent, third longitudinal with branch, discal cell emits two veins.

♀. Similar to the male. Front anterior to ocelli luteous bipunctate, and on both sides ornamented with an aureous tomentose spot. Above posterior to the orbit aureous tomentose, below covered with white. Dorsum of thorax closely aureous tomentose, pleuræ white pilose. Black abdominal stripe in third and fourth segments more dilated than in the male.

Hab.—Illinois (L. Baron).

Odontomyia varipes Loew. ♂. Cent. vi. 21

Green, dorsum of thorax except the posterior angles, triangular spot at the base of the scutellum, and except the large lateral spots of the abdomen and border of the fifth segment black. Legs brownish, first half of the femora and base of tibiæ yellow, apical half of tibiæ and tarsi brownish black; two submarginal cells, five posterior.

Long. corp. $5\frac{1}{3}$ lin., long. al. $3\frac{5}{8}$ lin.

Related to *Odontomyia megacephala*, but the head is smaller and diverse other markings on the abdomen. Vertical triangle black, yet the base green; frontal triangle minute black. First two joints of the antennæ cylindrical, equal; the first brownish black; the second ferruginous red; the third joint in this described specimen is wanting. Face green, superior margin black, not prominent; towards the oral aperture strongly receding, obtuse carinate. Proboscis dilute yellow, palpi concolorous, labelli black. Dorsum of thorax black, posterior angles green. Scutellum green, black spot of the base broadly triangular. Pleuræ green, a moderately dilute subfuscous spot. Abdomen black, angle of the first segment, a large lateral spot in the second and third, extending to the anterior and posterior margins, separated from the anterior margin by a black band, a lesser subrotund spot in the fourth segment, and the posterior and lateral borders of the fifth segment green. Venter wholly green. Femora dilute yellow, second half of anterior, last third of middle, and apex of posterior ferruginous red; tibiæ ferruginous red; apical half of anterior, apex of posterior, brownish black; tarsi brownish black;

first joint of posterior, except the apex, reddish, and base of the lowest anterior, brown. Wings pure hyaline, valid veins obscurely ochreous, third longitudinal with branch; the discal cell emits three equal veins.

Hab.—Carolina.

Odontomyia vertebrata Say.

♂. Mouth deep, black, pale within; hypostoma with an elevated testaceous knob; antennæ deep black, terminal joint beneath dusky, testaceous; thorax blackish, with hardly perceptible hairs; scutellum dull testaceous, black at base; tip a little hairy; spines horizontal, white; wings white; poisers white, with a whitish glaucous capitulum; feet yellowish white; abdomen subquadrate, much depressed, white; tergum with a series of large black spots almost connected together.

Length ♂ rather more than three-tenths of an inch.

Hab.—Northwest Territory.

Say, Complete Writ. i, 251; Long's Exped., App., 369. Wied. Auss. Zw. ii, 73, 20. Bellardi, Saggio, etc., i, 38.

Odontomyia Paron Walker. ♂ ♀.

♂. Body black; head as broad as the chest, clothed in front with short whitish hairs, red about the feelers; eyes reddish bronze; facets of the fore-part larger than those elsewhere; mouth black; feelers black, red at the base; chest and breast thickly clothed with tawny hairs; scutcheon armed with two tawny teeth; sides and under side of abdomen tawny, sometimes yellow and tinged with green; legs tawny; wings whitish; wing-ribs tawny; veins yellow; poisers tawny, with apple-green knobs.

♀. Head and chest bronzed; head black about the base of the feelers.

Length of body 3 lin., long. al. 6 lin.

Hab.—Trenton Falls.

Walker. Li-t iii, 536.

Odontomyia intermedia Wied. ♀.

Fühler schwarz, erstes Glied nur halb so lang als das dritte. Untergesicht schwarz, fast silberweisz behaart. Stirn mitten rostgelblich, an beiden Seiten schwarz, mit zwei fast silberschimmernden Flucken; am Scheitel erstreckt sich das Gelbe bis zu den Augen. Rückenschild schwarz, sehr kurz kiesgelb behaart; Brustseiten hingegen silberweisz behaart; Rand und Darmen des Schildchens gelblische. Hinterleib kaum weiszlich behaart; an

der Spitze der Abschnitte 2–4 an jeden Seite ein linienartiger rostgelblischer Fleck oder eine breit unterbrochene Binde; der Hinterrand des fünften Abschnittes überall lehmgelblich und mit dem Gelblichen des Seitenrandes zusammenfliesend. Bauch gelblich. Flügel wasserklar; Rippe und die zweite Ader bis zur Spitze des Rippenfeldes lehmgelblich; das Randmal und die mittlere Zelle umgebenden Adern rein braun; Schwingen schön grün. Beine lehmgelblich; Schenkel fast bis zur Spitze pechschwarz. In meiner Sammlung.

Länge 3½ Linien. Aus Nordamerika.

Wied. Auss. Zw. ii, 64, 5.

Odontomyia Virgo Wied. ♂.

Der europäischen *Str. viridula* äuszert ähnlich. Fühlerwurzel rostgelb, das dritte Glied ist verloren gegangen. Kopf schwarz. Untergesicht schneeweisz behaart. Rückenschild schwarz, mit greiser Behaarung; Brustseiten schwarz, schneeweisz behaart; Dornen des Schildchens lehmgelb. Hinterleib papageigrün, mit breiter schwarzer, an der Spitze jedes Abschnittes wenig verengerter, an der Wurzel des letzten Abschnittes abgebrochener Strieme. Bauch grün, an der Spitze jedes Abschnittes ein bräunlicher nicht scharf begräntzter Fleck. Flügel sehr wasserklar, mit lehmgelb Adern; Schwinger lehmgelb mit grünem Knopfe. Beine überall lehmgelb. In meiner Sammlung.

Länge 4 Linien. Von Savannah.

Weid. Auss. Zw. ii, 69, 13.

Odon omyia brevipennis Oliv.

Odontomyia scutello subbidentato nigra, abdomine maculis lateralibus flavis acutis.

Elle ressemble aux précédentes. Les antennes sont noires avec les deux premiers articles jaunes. La tête et le corcelet sont noirâtres, couverts d'un léger duvet d'un gris un peu rousseâtre.

L'écusson est noir, et armé de deux petites épines rapprochées, à peine apparentes, jaunes. L'abdomen est noirâtre en dessus, avec une suite de petites taches jaunes sur les côtés, triangulaires, avec leur angle interne trèsaigu. Le dessous est d'un jaune un peu livide. Les cuisses sont noirs, avec l'extrémité jaune. Les jambes et les tarses sont jaunes. Les ailes sont transparentes, avec les nervures légérement jaunes; elles sont courtes, et dépassent à peine l'abdomen.

Elle se trouve dans la Carolina, d'où elle a été appartíe par M. Bose.

Encycl. Method, viii, 434, 13.

Odontomyia cincta Oliv.

O. scutello bidentato, viridis, thoracis dorso nigra, abdomine nigro, fasciis tribus interruptis, flavis.

Elle est presqu'aussi grande que l'odontomyie fourchue. Les antennes sont jaunâtres. Le tête est verte ou jaunâtre, avec trois points noirs sur le vertex. Le dos du corcelet est noirâtre. Les côtés et l'écusson sont verts ou jaunâtres; celui-ci est armé de deux petites épines. L'abdomen est noir en dessus, avec trois bandes interrompues et un peu amincies au milieu, d'un jaune plus ou moins vert. Le dessous du corps est jaune ou vert. Les pattes sont jaunes. Les ailes sont transparentes, avec les nervures jaunes.

Elle se trouve en Carolina; Illinois.

Encycl. Method, viii, 432, 3. Macquart, Dipt. Exot. i., 2, 189.

Odontomyia flavicornis Oliv.

O. scutello bidentato, nigra, capite scutelloque flavis, abdomine maculis lateralibus argenteis.

Ella a un peu plus de trois lignes de longueur. Les antennes sont jaunes, avec l'extrémité noire. La tête est jaune, avec les yeux noirs. Le corcelat est noir, avec quelques raies formées par un duvet argenté. L'écusson est grand, jaune, armé de deux fortes épines de la même couleur. L'abdomen est large, court, un peu aplati, noir, avec quatre taches de chaque côté, formées par un duvet argenté. Les pattes sont noires, avec les genoux et le premier article des tarses blanchâtres. Les ailes sont transparentes, avec les nervures d'un jaunne-brun. Les balanciers sont jaunes.

Elle se trouve dans l'Amerique septentrionale.

Encycl. Method, viii, 433, 9. Macquart, Hist. Nat. Dipt., i, 248, 4.

Odontomyia hieroglyphica Oliv.

O. scutello mutico viridi, abdomine nigra, maculis lateralibus viridibus.

Elle est de la grandeur de l'odontomyie hydroléon. Les antennes sont noires. La tête est verte, marquée d'une tache noire, assez grande, à la partie antérieure; de deux autres un peu au dessus, sinueuses, et d'une triangulaire, anterieurement dentée, sur le vertex. Le corcelet est noirâtre avec le côtés et l'écusson verts; celui-ci est mutique ou armé de deux épines à peine appar-

entes. L'abdomen est noir, avec trois petites taches verdâtres sur les côtes, et une sur l'anus. Le dessous du corps est vert ou d'une vert-jaune. Les cuisses sont noires, avec l'extrémité jaune. Les jambes et les tarses sont jaunes, tachés de noir. Les ailes ont une légère teinte d'un brun-rousseatre, surtout vers le bord extérieur.

Carolina and Dist. Columbia.

Encycl. Method, viii, 434, 11.

Odontomyia interrupta Oliv.

O. scutello bidentato, nigra, abdomine fasciis tribus interruptis, anoque flavis.

Elle est de la grandeur de l'odontomyie tigrine. Les antennes sont noires. La tête est noire avec une petite tache oblongue, jaune sur le vertex. Le corcelet est noir, couvert d'un léger duvet court, argenté. L'écusson est de la même couleur, et est armé de deux petites épines jaunes. L'abdomen est noir, avec trois petites taches sur les côtés, d'une égale épaisseur, et une sur l'anus, d'un jaune-verdâtre. Les pattes sont jaunes, avec les cuisses presqu'éntiérement noires. En dessous la poitrine est noire, et l'abdomen est verdâtre. Les ailes sont transparentes, avec les nervures d'un brun-rousseâtre.

Carolina.

Encycl. Method, viii, 433, 8.

Odontomyia obscura Oliv.

O. scutello flavo mutico, nigra, capite flavo punctato.

Elle est de la grandeur de l'odontomyie tigrine. Les antennes sont noires, avec la base d'un jaune-obscur. La tête est noire, avec quelques points et le bord postérieur jaunes. Le corcelet est noir, couvert d'un léger duvet d'un gris-rousseâtre. L'écusson est jaune, sans épines, ou voit seulment quelques cils qui tiennent lieu d'épines. La poitrine est noire avec un peu de jaune sur les côtés. L'abdomen est noir, avec quelques taches triangulaires peu apparentes sur les côtés, formées par un léger duvet argenté. Le dessous est noir, avec tache verte à la base. Les cuisses sont noires, avec les genoux jaunes. Les jambes et les tarses sont jaunes. Les ailes sont transparentes, avec les nervures légérement jaunes.

Carolina.

Encycl. Method, viii, 433, 7. Macquart, Dipt. Exot., i, 2, 189.

MARCH 7, 1882.

The President, Dr. LEIDY, in the chair.

Thirty-five persons present.

The death of Joseph Pancoast, M. D., was announced.

The Relation of Heat to the Sexes of Flowers.—Mr. THOMAS MEEHAN observed that the best fields for biological research were to be found amongst objects with which we have already a more or less familiar acquaintance. One fact observed will prove a stepping-stone to higher knowledge. His first new discoveries in *Acer dasycarpum*, the common silver maple of our streets, were communicated to the Academy and published in the Proceedings for 1868, and there had been interesting observations made on this species in the line of those discoveries on many occasions since that time. In that paper it was noted that the tree was not polygamous, as stated in the text-books, but strictly monœcious or diœcious. There were no hermaphrodite flowers, but each tree was either male or female, though occasionally the separate sexes were found on the same tree. The male flowers have no trace of a gynœcium, but the female flowers have well-formed anthers, but never have pollen, or even perfect themselves by lengthening filaments, as in the perfect male flower. Notwithstanding the perfect form of the anther, the stamens in the female are abortive. But the chief physiological fact of importance noted in the paper of 1868, was that a tree which for years would produce nothing but female flowers would sometimes change the sex, and bear only male flowers; while no instance could be found of a male tree eventually producing female-bearing branches. During the fourteen years since this discovery was recorded, Mr. Meehan said he had found frequent instances of change from female to male as at first observed, but not one instance of change from male to female. There could be no doubt of the order in which the sexual change occurred. While the maple was growing vigorously it followed the rule with all trees and made no attempt to flower. With some check to the vegetative force, the reproductive power asserted itself, and flowering began; this is the second stage. With a greater check to the vegetative force, only male flowers resulted. This was the third stage. Since that time he had shown to the Academy that when a maple-tree passed from the vegetative to the reproductive condition, and bore at once male flowers only, it was a leap down from the first to the third stage, missing the second or female—for he had found that though the amount of vital power exerted in the production of seeds, and the immense loss of leaves which the production of seed implied (as

all know who are familiar with the silver maple after bearing a heavy crop of seeds), the female trees of the same age and under the same circumstances, were usually as large as the males which had no such strain on their nutritive powers.

He desired the members to pause here a few minutes, while he called their attention to another matter which he had recently brought to the notice of the Academy. It was in relation to the influence of heat on flower-buds. About the time of the fall of the leaf, there is little to distinguish a flower-bud from a leaf-bud. But the flower-bud continues to grow at a comparatively low temperature at which the leaf-bud remains stationary. Even when the thermometer was several degrees below the freezing point, flower-buds would increase in size, though naturally much more rapidly when above this line. In the peach, the growth of the flower-bud was very rapid between 32° and 40° Fahr., until by early spring they will have reached often as much as three-fourths larger in size. Indeed, a peach-bud will often have its flowers fully expanded before the leaf-bud has scarcely begun to grow. We learn from this lesson that it takes less heat to develop a flower-bud than a leaf-bud. In the light of these observations, he had been watching during the past winter the behavior of the buds on the silver maple. These advanced gradually until, by February 23, they commenced to expand—the leaf-buds remaining as they were at the fall of the leaf. They had been expanding continually as the days were warmer or colder, up to the present date (March 7), but the expanding blossoms have been wholly male flowers. Only to-day, as noted in the specimens exhibited, were the purple tips of the pistils visible through the parting bud-scales. It was obvious that here we had reached another important stage in the life history of the maple-tree. First, it requires less heat to induce growth in a maple flower-bud than a leaf-bud; secondly, it requires less heat to induce growth in the male flower than in the female.

Comparing the male with the female trees, Mr. Meehan noted differences in their habits of growth. Taking a twig of the last season's growth, in a flowering condition, one or two blossoms might appear alongside of the leaf-bud, in trees of either sex. So far we could find no difference. But in the female tree the central or leaf-bud, when it pushed into growth in the spring, made a shoot of several or many inches in length according to the vigor of the tree or parent branch. In the male tree, on the contrary, the central growth was not more than perhaps a quarter of an inch, forming a mere tuft of leaves on the top of what was a head of male flowers. In fact these branches were reduced to mere spurs, and weak spurs at that. He had measured these little branches or spurs which had been bearing male flowers for ten successive years, which were not more than from three to five inches in length, and not thicker than wheat straws. It was from these spurs that the great mass of opened flowers appeared. The male

flowers on the shoots of last year did not advance as did the flowers on the spurs. It is very important to note this fact. These are only now opening, and are cotemporaneous with the opening of the female flowers which, like them, are sparsely arranged around the axillary bud of the past season. The immense amount of pollen from the early flowers, forming the great bulk of all the pollen produced by the tree, is scattered before the female flowers open, and is absolutely useless for any purpose of fertilization, or useless for any purpose of individual benefit to the tree or to the race, so far as we can see. These later-opening flowers, formed on the wood of last year, are evidently the chief reliance, if not the only reliance, of the female flower for its reproductive energy.

Just here an objection may be raised. If it be heat alone which advances the male flowers on the spurs, why does it not advance them on the wood of last year? If it take less heat to bring forward a male flower than a female flower, why is not this power exhibited when the separate flowers happen to be on branches both apparently alike in vital conditions? Here we may return to the point we diverged from. We have seen that there are successive stages from a high vegetative, but unproductive condition, to one of fertility; and again one lower than this, lower in comparison with vegetative power, in which the purely male or sterile condition is reached. In other words, a highly vital condition is more closely allied with those attributes which characterize the female sex than with those characteristic of the male, and we may therefore reasonably look for some influence in the female direction on the male flower where these conditions exist. Therefore male flowers on a shoot characterized by a highly vitalized condition, would be likely to resist influences to which they would be otherwise subjected. In short a male flower on a strong branch ought not to yield as readily to the excitement of heat as one growing on a weak branch. At any rate the fact that the whole of the weak spurs of the maple-tree produce nothing but male flowers, and that these male flowers expand at a lower temperature than the females do, is conclusive as to the law, whatever answer the objection may receive.

This law, thus demonstrated, will be of great practical value to culturists. So far as the single point of the advancement of the flowers by a low temperature is concerned, the peach-grower will be interested in keeping the temperature cool so that there shall be no advance of the flower until the temperature is high enough to bring forth the leaf-buds as well. Now we can go further and understand why some amentaceous plants so often produce no fruit or imperfect seeds. It is well known that isolated trees of birch, though producing abundance of male and female flowers, very often have not a perfect seed. We may now see how the catkins may be brought forward by a low temperature not sufficient to excite the female flowers, and thus lead them to mature

and shed their pollen before the weather is warm enough to bring forward the female blossom to receive the necessary pollination. In seasons where the weather is cool till the regular springtime comes, or in climates where there is little very exciting warmth till the regular growing time arrives, there is not likely to be so great a period between the opening of the male and the female flowers. That this is the case with the common European hazel or filbert as grown in this country, an examination to-day clearly indicates. The catkins have attained their full length, and the anthers are ready to shed their pollen with another day's sun, but there is no sign yet of the little purple stigmas bursting through the scales of the buds which form the female flowers. Should the anthers disperse their pollen to-morrow, as they doubtless will if the temperature rises to 45°, there certainly can be no fertilization, and consequently no hazel-nuts from the trees in question next year. It was a well-known fact that the European hazel-nut often failed to bear nuts in this part of Pennsylvania, and we have clearly the explanation in the facts now developed. In Europe there were seldom such failures, the climate being probably favorable, more favorable to the simultaneous production of male and female flowers.

Mr. Meehan then briefly referred to the influence which these new facts must have on questions of dichogamy. There need not necessarily be any constant rule in the production of proterandrous or proterogynous flowers. We might expect to find proterandry prevailing to a greater extent in plants growing where there was a more constant succession of warm and cool days, than in the same species growing where the climate is not what is called changeable, that is to say, where the temperature was regularly low until the regular spring season had arrived, in which case there would not be much difference in time between the advance of stamens or pistils.

In conclusion he said, if he might be allowed to generalize from this experience with the maple-tree, the following principles seem proven:—

Male flowers do not appear on female maple-trees till some of its vital power has become exhausted.

Branch-buds bearing female flowers, have vital power sufficient to develop into branches.

Branch-buds bearing male flowers, have not vital power enough to develop into branches, but remain as spurs, which ever after produce male flowers only.

Buds producing male flowers only, are more excited by heat than females, and expand at a low temperature under which the females remain quiescent.

A few warm days, succeeded by cooler ones, will therefore make a corresponding difference in time between the opening of the male and the female flowers, and possibly in the proportionate advancement of the stamens and pistils in hermaphrodite flowers.

Professor Heilprin remarked that in the south of France there were often warm days in winter, much as we have here, but he believed there were no failures in the hazel-nut there.

Mr. Meehan said that when he used the word Europe, he had England in his mind, as his own personal experience was chiefly drawn from there. In that country, he believed, the catkins were never brought on by warm days in winter, so as to mature before there was warmth enough to develop the female flowers.

The President, Dr. Joseph Leidy, inquired whether the American species (*Corylus Americana*) exhibited the same characteristics as the English species?

Mr. Meehan replied that he believed it would be found to do so, in some degree.

On Balanoglossus, etc.—Prof. Leidy stated that in a recent trip to Atlantic City, he had observed the singular worm, *Balanoglossus aurantiacus.* It occurs in moderate number along the shore of a pond between the beach and the lighthouse. In the same position he had collected *Solen ensis*, specimens of which were presented this evening. As this occurred in considerable number, he had procured a sufficient quantity to try it as an article of food, and had found it to make excellent soup. In the vicinity he had picked up a number of specimens of *Actinia rapiformis*, which had been recently thrown upon the beach. On a former occasion, at Atlantic City, he had observed another Actinia, the *Bicidium parasiticum*, which is parasitic on the large jelly-fish, *Cyanea arctica*, so frequently thrown on shore during the summer.

Scolithus in Gravel.—Prof. Leidy remarked, that since making the communication on some rock specimens, he had been led to suppose that if the quartzite pebbles of our gravels were largely derived from the Potsdam sandstone, the characteristic fossil, *Scolithus*, would be found as an occasional associate. With this view he had recently taken an opportunity of examining a gravel bank on the University ground, and had there picked up the three specimens exhibited, with well-marked *Scolithus*, which were broken from as many boulders. He also directed attention to specimens presented by Mr. John Ford. These consist of pebbles of a chalky white porous siliceous rock, with impressions of brachipod shells, which were picked up from the gravel of the reservoir at Fairmount Park.

March 14.

The President, Dr. Leidy, in the chair.

Twenty-three persons present.

The death of Geo. B. Dixon and that of James Lanman Harmer, members, were announced.

On the Occurrence of Ammonites in Deposits of Tertiary Age.—Professor ANGELO HEILPRIN stated that he desired to place on record the discovery of the remains of ammonites in deposits of tertiary age. Hitherto the members of this group of cephalopod mollusks were considered to have become extinct with the cretaceous mesozoic) period, no form having thus far been found either in Europe or America, or in any other country whose geology had been worked up, that could with positiveness be stated to have transgressed the limits of this period. The specimen particularly referred to (now in the possession of the Academy) was found imbedded in a rock fragment belonging to the so-called Tejon group of Fort Tejon, California, a series of rock deposits considered by the late Mr. Gabb and Prof. Whitney, of the California Survey, to represent the uppermost member of the cretaceous deposits of that State. Mr. Heilprin stated that having recently had occasion to carefully study the fossil organisms contained in the Tejon rocks, and the types of the collection (deposited in the Academy Museum) which form the basis of Gabb's important work on the palæontology of California, he had arrived at the conclusion that these so-called cretaceous deposits were unquestionably tertiary, a view which had likewise been maintained for some time by the late Mr. Conrad, but which, in the absence of positive evidence, appears to have been subsequently abandoned. Mr. Heilprin further remarked that, with the exception of one solitary fragment of an ammonite, there was, to his knowledge, not a single distinctively cretaceous type of organism to be found in all the rock fragments, but, on the contrary, several genera, distinctively tertiary, and not known anywhere to have appeared before that period, were characteristic of these fragments. Furthermore, these last contained a few species undistinguishable from forms found in the tertiary deposits of the eastern United States. In answer to certain remarks made by Dr. HORN, as to the stratigraphical position occupied by the rocks whence the specimens were obtained, Prof. Heilprin stated that he was aware that the deposits in question had been described as lying conformably with the cretaceous, but that stratigraphical position by itself was no criterion for determining the geological age of a horizon, the only true test being the facies of the contained organic remains. The discovery of ammonitic remains in tertiary strata need not especially surprise the geologist, since recently Prof. Waagen, of Vienna, had announced their discovery in the carboniferous of India, two degrees lower in the geological scale than the deposits they had up to that time been supposed to characterize.

MARCH 21.

Mr. MEEHAN, Vice-President, in the chair.

Twenty-seven persons present.

On the Condylarthra.—Professor COPE made some observations on the characters of the newly-discovered group of Perissodactyle ungulates, which he had called the *Condylarthra*. He defined it as follows, comparing it with the typical *Perissodactyla*, which he referred to a suborder, under the name *Diplarthra:*

Astragalus with one uniformly convex distal articular face; humerus with epicondylar foramen. *Condylarthra.*

Astragalus with two truncate or concave distal articular facets for the cuboid and navicular bones; no epicondylar foramen of humerus. *Diplarthra.*

The *Condylarthra* have as yet been only found in lowest horizon of the Eocene period, the Puerco and Wasatch, and only on the North American Continent. Appropriately to this position in time, its structure indicates that it is the most primitive type of the order of the *Perissodactyla*. A number of genera and species belong to it, and these fall into two families, which are defined as below. They conform to the definitions of the order, in possessing an alternating arrangement of the carpal bones, and a third trochanter of the femur. The approximation to the *Hyracoidea* is greater than that of any group of the *Perissodactyla*. That order agrees with the *Condylarthra* in the simple articular extremity of the astragalus, which is, however, less convex; but it has a very peculiar articulation with the anterior face of the distal extremity of the fibula, seen in no other group of ungulates. In the manus the lunar bone is very peculiar, not being divided below into two facets as in other ungulates, and articulating with the carpals of the trapezoides series (the intercalare) as well as with the unciform. In these points the *Condylarthra* agree with other *Perissodactyla*. In *Hyrax* there is also no epicondylar foramen. The two families are defined as follows:

Dentition bunodont; toes 5–5; premolar teeth different from the molars above and below. *Phenacodontidæ.*

Dentition lophodont, with crescents and deep valleys; premolars partly like molars below; toes ? *Meniscotheriidæ.*

The bunodont dentition and five toes on all the feet, give the *Phenacodontidæ* the lowest place in the suborder and order, as the most generalized type known. The *Meniscotheriidæ* have a quite specialized dentition, and until I learned its condylarthrous character, I was at a loss to account for the presence of such perfection in so old a type. The number of the toes is yet unknown, but I suspect from the large size of those I have seen, that they

are less numerous than in the *Phenacodontidæ*. It appears to have had no descendants, and is a good illustration of Dr. Kowalewsky's views as to the persistence of the "adaptive" over the "non-adaptive" types of articulation. Kowalewsky observed that the type of Ungulata which have the carpo-metacarpal, and tarso-metatarsal articulations, simple and not alternating, have become extinct. In those which persisted, the metapodials articulate with two bones of the carpal or tarsal series. The same rule has generally applied in the Ungulates to the distal astragalar articulation. The *Diplarthra* and *Amblypoda*, with the double articulation, have left descendants, while the *Condylarthra*, with the single articulation, have disappeared without leaving a trace. The *Proboscidea*, which have the same simple distal articulation, still remain, however, to show an exception to this generalization.

The *Condylarthra* are distributed as follows:

	Puerco.	Wasatch.
PHENACODONTIDÆ.		
Anacodon,		1
Phenacodus,	2	8
Protogonia.	1	
Pantolambda,	1	
Catathlæus,	3	
Anisonchus,	1	
Haploconus,	3	
Periptychus,	1	
MENISCOTHERIIDÆ.		
Meniscotherium,	3	
	15	9

The genera of *Phenacodontidæ* are distinguished as follows:

I. Fourth superior and inferior premolars with an internal cusp.
  Last superior premolars with two external cusps; inferior molars with well-developed cusps. *Phenacodus.*
  Inferior molars with flat grinding faces; no cusps. *Anacodon.*
  Last superior premolar with but one external cusp; inferior molars with *Vs*. *Protogonia.*
  Inferior premolars consisting of an anterior *V* and a posterior longitudinal crest. *Pantolambda.*

II. Fourth superior premolar with a high internal cingulum concentric with the single external cusp.

a. Superior molars with intermediate tubercles; fourth premolars with internal cusps.
  Posterior inner tubercles of the superior molars not cut off; several superior premolars with internal cingulum. *Catathlæus.*

aa. Superior molars with intermediate tubercles forming branches of a *V* with the anterior inner; posterior inner distinct and cut off by a groove; inferior premolars without inner cusps; first inferior true molar tubercular.
  Third superior premolar with elevated internal crest. *Anisonchus.*
  Third superior premolar a cone without inner crest. *Haploconus.*

aaa. Superior molars unknown; inferior true molars with anterior lobe; the first with a transverse heel instead of opposite tubercles.
  Anterior external lobe of inferior molars forming a cutting edge. *Periptychus.*

The only genus of the above, in which the structure of the feet is well known, is *Phenacodus*. It is partially known in *Catathlæus*.

The only genus of *Meniscotheriidæ* is distinguished as follows:

Inferior premolars consisting of two *Vs*. *Meniscotherium*.

Variation in the Nest Forms of the Furrow Spider, Epeira strix.—Rev. Dr. H. C. McCook remarked that he had observed that some of the orbweaving spiders had a marked tendency to vary the forms of their nests. The spinning work of spiders may be classified as (1), the *snare*, spun for the capture of prey; (2), the *enswathment*, by which insects are disarmed and prepared for food; (3), the *gossamer*, used for purposes of aqueous or aerial locomotion; (4), the *cocoon*, spun for the propagation and protection of the species; and (5), the *nest*, which is a domicile more or less elaborate and permanent, within or under which the aranead dwells for protection against enemies and weather changes. As a rule, the great groups of Orbweavers differ from each other and agree within themselves in the characteristic form of nest. The form prevailing in each family is substantially the same; each species appears to adhere quite steadily to one characteristic form; but there are some marked variations in the habit of certain species, the most decided of which have been observed in the case of *Epeira strix*. Some examples of this were given.

1. The ordinary nest of Strix when domiciled in the open field or wood, is a rolled leaf. A single leaf is taken, the edge pulled up, drawn under and fastened by adhesive threads into a rude cylinder, within which the spider hides during the day-time. A thread connection with the foundation lines of the snare is maintained; but rarely with the centre of the orb by a taut trapline as is the habit of the Insular spider, *Epeira insularis*.

2. A second form of nest varies from the rolled leaf nest, in having the edges of two adjacent leaves bent towards each other and lashed together on the exterior at the juncture by silken cords, and on the interior by adhesive tissue-web. An oval opening is left at the united points of the leaves, through which the connecting line passes to the snare. The spider domiciles within the leafy cavern thus formed.

3. Again, the spider avails herself of small holes in wood or stone, openings in fences, the interspace between curled bark on the trunk of old trees, or some like cavity, which she appropriates as a nesting-place. A slight lining will generally be found upon the concave surface. Dr. McCook had noticed that in such cases the snare is sometimes diverted from its normal shape in order to give a covenient approach thereto from the den. One such example was found spun between a side of the Peace Fountain in Fairmount Park (Philadelphia) and the stone wall adjoining.

In order to pitch her tent within a hole in the rock, the spider diverted one of the radii from the plane of the orb and extended it backward to the hole. The spirals which passed over this radius thus made an elbow or angle, which was indeed nearly a right angle, and gave the orb an odd, broken appearance. The radius, of course, served as the bridge-line by which Strix passed from her den to her snare.

4. Another variation was due to an accident in the environment of the web. A half-grown Strix had woven a snare in the hollow of a decayed tree (at New Lisbon, Ohio), within two feet of the ground. A colony of the Pennsylvania carpenter ant (*Camponotus Pennsylvanicus*) had quarters in the tree, a squad of black workers were busy excavating their wooden galleries. These dumped their chippings from openings just above the spider's orb, whose viscid spirals retained goodly quantities of the brown sawdust. In course of time a ball of chippings as big as a walnut had accumulated, or, perhaps had been purposely massed by the spider. However that may be, the ball was utilized as a nest; its centre had been pierced, a spherical cavity formed by silk-lining the interior, which was entered by a circular door bound around the edge by spinning-work. This quaint domicile was pendant from one of the strong upper foundation lines, and herein Strix rested, while the emmet carpenters worked away above her, continually dropped chips upon the roof of her den, and the orb beneath, until one side of the snare was quite covered with them. In this case the position of the nest, as well as its form was exceptional, as the nest site of Strix is well nigh invariably beyond the limits of the web, sometimes, indeed, several feet. In these points the spider was evidently led to an intelligent variation of her nest-building by circumstances.

5. Another variation, or rather a series of variations, was noted upon the side of Brush Mountain at Bellwood, Pennsylvania. Several young pine-trees had been cut away and tossed from the mountain to the banks of the Juniata River below. The foliage had withered and fallen from the boughs, whose branches stretched out dry and bare, and among them a colony of young furrow spiders had pitched their tents and spread their snares. One specimen happened to spin her web near the axil of several goodly sized branches, which were formed into a natural shelter by the inverted position of the bough. The spider had recognized this vantage, and made her nest at the point of juncture, or rather took shelter there, for there was very little artificial nesting beyond a faint tissue spread over the bark at the point where she sat.

A second specimen had lodged at a point near the tip of a small branch whose delicate dry twigs gave no sufficient shelter, and besides, were directed upward. Accordingly a silken tube, funnel-shaped, was spun between the twigs, within which young Strix nested.

A third spider lodged in a similar site, had made a silken sack for a tent, whose mouth had apparently originally opened directly toward the snare. But a saltigrade spider had fastened a parasitic tubular nest upon one side of this sack, and accordingly the mouth was found closed and the door shifted to the opposite side, as though to avoid interference with a troublesome neighbor.

A fourth individual had woven a simple silken cover or screen, behind which she lodged. A fifth had pitched her tent upon a stray leaf beneath which a similar cover, a small rectangular piece of silk canvas (suggestive of the military bivouac or "dog tent") was stretched by lines attached to the sides and corners, and fastened to the leaf surfaces and surroundings. Between this sheet and the leaf the spider was ensconced having the usual bridge-line connection with the orb.

6. Two of the above colony had established nests in tufts of a parasitic moss fastened upon the dead limbs. One of these was very pretty and ingenious. The moss grew in a bunch about the size of a hickory-nut; this was pierced at the top, and the filaments pushed aside sufficiently to allow an interior cavity large enough to house a spider. An oval door or opening was formed near the top by bending and binding back the fibres of the plant. A secure and tasteful retreat was thus obtained at the only really available spot in the vicinity of the snare.

7. When the furrow spider weaves her orb upon the exposed surfaces of human habitations, as the cornices of porches, outhouses, etc., her nest takes a form quite different from any of the above. A tube of stiff silken fibre is spun against the surface to which it is lashed at all sides. This cylinder is about an inch long and half-an-inch thick, and at the end toward the orb has a circular opening about a quarter of an inch in diameter. The stiff texture of the nest appears to be necessary to make the walls self-supporting, inasmuch as there are no supports like the twigs and leaves found at hand in arboreal sites. Moreover, the open position of the domicile exposes the spider very freely to the assaults of the mud-daubers who frequent such localities, to birds and other enemies, so that a canvas is needed of tougher texture than that required in sheltered sites. It may be remarked that in old buildings, which present cracks and crannies convenient for nesting, woven nests of this sort will rarely be found.

It is thus seen that while there is a general regard to protection of the spider's person, there is a modification over a quite wide degree of variation in the form of the protective nest. Further, that this modification appears to be regulated more or less, by the accidental environment of the domicile, and in such wise as to show no small degree of intelligence in adapting the ordinary spinning habit to various circumstances, and to economizing labor and material.

MARCH 28.

The President, Dr. LEIDY, in the chair.

Forty-one persons present.

The death of R. S. Kenderdine, M. D., and that of Solomon W. Roberts, members, were announced.

Mr. Isaac C. Martindale offered the following, which was adopted and ordered to be printed:—

This Academy having learned with deep regret of the death of its worthy member and curator, Robert S. Kenderdine, M. D., and desiring to place upon record the regret we feel in thus having to part with his valued services as an officer and his agreeable company as a member, a regret increased by our recollection of the geniality and open-heartedness which always characterized his association with us, therefore

Resolved, That realizing the loss which has been sustained, we tender to his family our sincere sympathy in this hour of affliction.

Resolved, That a copy of these resolutions, signed by the President and Recording Secretary, be forwarded to his family and that they be entered in full upon the minutes and published in the Proceedings.

Art. XIV, Chap. V, of the By-Laws, was amended by striking out all of the article after the word "meetings" in the third line, and inserting "and with like approval may change the same."

Geo. Taylor Robinson, M. D., Eugene M. Aaron, and John Edgar were elected members.

An American Locality for Helvite.—Prof. H. CARVILL LEWIS remarked that among some minerals which he had recently obtained from the mica mine near Amelia Court House, Virginia, a locality already well-known for its microlite and other rare minerals, was a yellow crystalline substance, which upon examination had proved to be *Helvite.* The mineral occurs in crystals and friable crystalline masses imbedded in bluish white orthoclase, and is generally associated with pale red topazolite. While no crystals were found sufficiently perfect to allow of measurement, the absence of any action upon polarized light proved their isometric character.

The mineral has a hardness of about 6, a specific gravity of 4.306, a sulphur-yellow color, a somewhat resinous lustre, and is partially translucent. It fuses at about 4 with intumescence to a

brown glass, gives no water in the closed tube, and with the fluxes gives the reactions for manganese. Fused on charcoal with soda, it gives a hepar. It is soluble in hydrochloric acid, evolving sulphuretted hydrogen and leaving a residue of gelatinous silica.

Its composition, as kindly ascertained by Mr. Reuben Haines, is as follows:

SiO_2	23.10
BeO	11.47
MnO	45.38
Fe_2O_3	2.05
Al_2O_3	2.68
CaO	.64
K_2O	.39
Na_2O	.92
S	4.50
Gangue	9.22
	100.35

In the analysis the glucina and manganese were first separated from alumina and iron by long boiling with ammonium chloride, and were then separated from each other by repeated precipitation by ammonia, the manganese being thrown down by sodium phosphate and weighed as pyrophosphate.

The mineral was separated from the associated impurities by placing upon a filter the total silica, which had been separated by evaporation with acid in the usual manner, and washing it seven or eight times with a hot concentrated solution of sodium carbonate. By this means all the soluble silica of the mineral was separated from any particles of quartz, orthoclase, or other insoluble silicates.

Regarding a part of the manganese as combined with sulphur, and deducting a proportionate amount of oxygen from the analysis, it will stand:

SiO_2	23.10	or, without gangue,	SiO_2	25.48
BeO	11.47		BeO	12.63
MnO	35.40		MnO	39.07
Al_2O_3	2.68		Al_2O_3	2.95
Fe_2O_3	2.05		Fe_2O_3	2.26
CaO	.64		CaO	.71
K_2O	.39		K_2O	.43
Na_2O	.92		Na_2O	1.01
Mn	7.73		Mn	8.66
S	4.50		S	4.96
Gangue	9.22			
	98.10			98.16

This result differs considerably from the analyses of Helvite heretofore published, and does not lead to the formula usually given to Helvite. It is desirable that further investigation should be made when more material is discovered.

Helvite has not previously been found in America.

APRIL 4.

The President, Dr. LEIDY, in the chair.

Twenty-nine persons present.

On Sagitta, etc.—PROF. LEIDY stated, that in a recent trip to Atlantic City, N. J., he for the first time met with the singular worm *Sagitta*. It occurred in large number in the same pond in which he had previously noticed *Balanoglossus*. Whether it was there at the time of his former visit he was unable to say, as the animal is as transparent as the water in which it lives, and may easily escape observation. His attention was accidentally directed to its discovery. Along the edge of the pond there were numerous linear white bodies, flaccid and motionless, which he at first took for fragments of a bleached alga. From the uniformity of their size he stooped to examine them more closely, when he noticed others in the water, more transparent, lying on the sand and occasionally moving suddenly and so actively as to send a little spray above the surface. On transferring some of these bodies to a vial he detected their nature. Subsequently the water was seen to swarm with the little creatures. They are exceedingly sensitive and quickly die after removal. In life they are perfectly transparent and colorless, and move actively at intervals with a sort of spasmodic jerk, bending the tail downwards and darting forward. After death they become flaccid, dull and white, and hence the appearance of the multitude of dead ones on shore.

The Sagitta is interesting as being one of those peculiar animals which have puzzled naturalists as to its exact relative position. It is now usually regarded as the representative of an order of worms with the name of Chætognatha.

A species, *Sagitta elegans*, has been described by Prof Verrill, as occurring at Wood's Holl, Vineyard Sound, and Gay Head, on the New England Coast, and he refers to a second undetermined species occurring in Vineyard Sound.

The Sagitta of Atlantic City appears to differ from the former, and also from all other described species found elsewhere, and may be readily distinguished from them by its greater number of mandibular hooks. It may be characterized as follows:

SAGITTA FALCIDENS. Animal transparent, colorless; body compressed, elongated fusiform, with two pairs of lateral hemielliptical fins, separated by intervals from each other and the broad obcordate caudal fin, which is truncated posteriorly. Head obcordate, about as broad as it is long. Pre-

oral series of spines, 6 or 7 in each, minute; postoral series 18 in each, successively decreasing. Mandibular hooks, from 11 to 14 in each series, usually 12, besides an immature one, scythe-shaped, yellowish brown in color. Length, about three-fourths of an inch; width, 1¼ to 2 mm. Head 1 mm.; caudal fin 1.5 to 1.75 mm. wide. Mandibular hooks 0.75 mm. long.

At the same time, as previously, numerous mounds of the *Balanoglossus aurantiacus* were observed. There were also noticed in the same pond, many projecting tubes of sand, which were found to contain *Clymena torquata.* Further, several specimens of *Glycera americana* were collected. On the shore of the pond in one place *Donax fossor* appeared to have its residence; and among *Solen ensis*, a single living *Solecurtus gibbus* was found.

APRIL 11.

Mr. S. FISHER CORLIES in the chair.

Twenty-three persons present.

A paper entitled "Description of new species of Terrestrial Mollusca of Cuba," by Rafael Arango, was presented for publication.

APRIL 18.

Dr. W. S. W. RUSCHENBERGER in the chair.

Thirty-four persons present.

Orthite from Amelia C. H., Va.—Prof. GEORGE A. KÖNIG communicated the discovery of orthite among the minerals occurring at the mica mine of Amelia Court House, Va. The speaker has seen only two fragmentary crystals, a large one, nearly four inches long by one inch wide and one-fourth of an inch thick. Both ends were broken. It presents the combination of a flat prism with the brachypinakoid. In the position of epidote the prism will be equal to a series of brachydomes. There is a pronounced cleavage parallel to the macro- and brachypinakoids and to the basal plane. The crystal is enveloped by a thin reddish brown crust of soft altered material, while the interior is pitch black and hard. Fracture uneven. A plate was cut parallel to the basal plane which only became green translucent at a thickness of $\frac{3}{1000}$ of an inch. It was found that a number of opaque small spots were scattered through the leek-green mass on a few spots showing strong polarization, which are probably hydromuscovite.

This section behaves like a uniaxial substance; it is dark with crossed prisms, and light when their position is parallel. The plane of the optical axes is therefore parallel to the basal plane.

Specific gravity at 17 C° = 3,368. A thin splinter boils up in the strong flame of a blow-pipe, and fuses to a dark blebby slag. With borax in O. Fl. a manganese bead. Decomposed by concentrated hydrochloric and also by moderately dilute sulphuric acid. Its composition is

SiO_2	=	32.90
Al_2O_3	=	17.80
Fe_2O_3	=	1.20
CeO_2	=	8.00
La_2O_3 / $Dy\,O_3$	=	14.20
FeO	=	10.04
CaO	=	11.32
MnO	=	1.00
H_2O	=	3.20
		99.66

Yttrium and glucinum are not present; but a trace of uranium was determined.

APRIL 25.

The President, Dr. LEIDY, in the chair.

Thirty persons present.

The death of M. W. Dickeson, M. D., a member, was announced.

The death of Chas. R. Darwin, a correspondent of the Academy, having been announced, the following were unanimously adopted:

WHEREAS, The Academy of Natural Sciences of Philadelphia, has heard of the death of Charles R. Darwin, F. R. S., of Down, Kent, England, be it

Resolved, That the Academy of Natural Sciences of Philadelphia hereby expresses its sense of the great services which have been rendered to science and scientific thought by Mr. Darwin, and of the great loss which it in common with the entire scientific world has sustained in his death.

Resolved, That the Academy desires to express its sympathy with the family of Mr. Darwin in their bereavement.

Resolved, That a copy of these resolutions be sent to the family of Mr. Darwin.

Dr. Chas. R. Schäffer was elected a Curator to fill the vacancy caused by the death of Dr. Robt. S. Kenderdine.

Dr. Thos. Moore was elected a member.

The following was ordered to be printed:—

DESCRIPTIONS OF NEW SPECIES OF TERRESTRIAL MOLLUSCA OF CUBA.

BY RAFAEL ARANGO.

Chondropoma deceptor Arango.

Testa umbilicata, oblongo-turrita, tenuiscula, costis longitudinalibus lirisque elevatis confertis decussata, pallide aurantiaca, fasciis interruptis rubris fere, sæpius obsoletis ornata; spira regulariter attenuata, sublate truncata; anfractus superstites 5 convexi, ultimus circa umbilicum angustum distincte spiraliter striatus; apertura verticalis, angulato-ovalis; peritrema duplex, internum nitidum, externum late patens, concentrice striatum ad anfractum contiguum angustatum, umbilicum lamina lata fornicata fere tegens. Operculum flavescens.

Longitudo testæ truncatæ 22–25 mill., diam. 10 mill., cum peritremata 15 mill.; apertura 7 mill. longa et 5 mill. lata.

Simile quoad umbilicum et testæ formam *Chondr. canaliculato*, sed bene distinctum ab hoc et *echinulato* atque *sinuoso* sculptura non asperata.

Habitat.—" Mogote de la Iagua " prope La Palma in Provincia Pinar del Rio in agris D. Rafael Azcui.

Chondropoma Hamlini Arango.

Testa umbilicata, oblongo-turrita, tenuis, nitens, liris spiralibus et costulis longitudinalibus æque distantibus echinatim decussata, rubella, fasciis interruptis rubro-fusciis (in ultimo anfr. 7) ornata; spira regulariter attenuata, late truncata; anfr. superstites 4, ultimus circa umbilicum angustum spiraliter substriatum; apertura verticalis, angulato-ovalis; peritrema simplex, nitidum, læve, expansum, sed ante anfractum contiguum angustatum eumque non attingens. Operculum rubellum.

Longitudo testæ truncatæ 15 mill., diam. 11 mill., cum peritremate 19 mill.; apertura 4 mill. longa, 3 mill. lata.

Habitat.—" Cerro de Cabras, vega de los Franceces dicta " prope oppitum Pinar del Rio.

Cylindrella triplicata Arango.

Testa subrimata, cylindraceo-turrita, solidula, remote filoso-striata, straminea; spira elongata, medio paulo ventrosior, apice plerumque truncata; anfr. 15–16 planiusculi, ultimus breviter

solutus, non carinatus; apertura subcircularis; peritrema album, undique æqualiter reflexum; sutura profunda, non crenulata.

Longitudo testæ integræ 14 mill., diam. 3 mill.

Columna interna fortis, lamellis 3 validis æqualibus parallelis munita.

Differt ab omnibus *Cylindrellis* cubanis forma columnæ internæ. Forma testæ similis est *C. liratæ* Jim. et *mixta* Wr.

Habitat.—"La Jagua" prope La Palma in Provincia Pinar del Rio in agris D. Rafael Azcui.

Cylindrella atropurpurea Arango.

Testa rimata, subcylindrica, tenuiscula sæpe breviter truncata, arcuatim costulato-striata, atropurpurea, nitens; sutura impressa, non crenulata, anfr. testæ integræ 13 vix convexiusculi, subæquales, ultimus breviter solutus, non carinatus; apertura subcircularis, intus fusca; peritrema continuum album, tenue, breviter expansum.

Longitudo testæ integræ 19 mill.; diam. 4 mill.

Columna interna simplicissima.

Comparata cum *C. pruinosa* Mor. differt magnitudine minori, colore, costulis confertioribus, peritremate magis expanso et præcipue columna interna simplici.

Habitat.—"La Jagua" prope La Palma in Provincia Pinar del Rio in agris D. Rafael Azcui.

Cylindrella colorata Arango.

Testa vix rimata, fusiformi-cylindracea, tenuis, oblique obsolete costulata, fuscula, basi fascia filari rufo-brunnea, in parte inferiori prope suturam in omnibus anfractubus conspicua ornata; spira elongata, sæpe breviter truncata, sutura subcrenulata; anfr. 13–14 planiusculi, ultimus fortius costulatus, solutus; apertura subovalis, plica columellari coarctata; peritrema album, expansum, non flexuosum.

Longitudo testæ integræ 24 mill., diam. 4 mill.

Habitat.—"La Chorrera" in Provincia Pinar del Rio.

Cylindrella infortunata Arango.

Testa non rimata, subfusiformi-turrita, tenuis, diaphana, chordato-costata, albida; spira breviter truncata, sutura profunda non crenulata; anfr. superstites 12, planiusculi, ultimus basi obsolete carinata; apertura et peritrema ? (unicum specimen fractum est).

Longitudo testæ sine anfractu ultimo imperfectæ 10 mill., diam. 3 mill.

Columna interna 3-plicata, plica superiori ampliori.

Habitat.—"La Chorrera" in Provincia Pinar del Rio.

Cylindrella prima Arango.

Testa rimata, cylindraceo-turrita, solidula, subconfertim obsolete costata, albida; spira supra medium sensim attenuata (in specimine unico) truncata; sutura crenulata; anfractus superstites 13, planiusculi, ultimus basi carinatus, antice breviter solutus; apertura obliqua, subcircularis; peritrema breviter expansum antice ob carinam subsinuatum.

Longitudo testæ truncatæ 17½ mill., diam. 4 mill.

Columna interna plicis 2 descendentibus ornata.

Habitat.—Cuba.

Cylindrella confusa Arango.

Testa rimata, cylindraceo-turrita, solida, confertim striata, albida; spira supra medium sensim attenuata, breviter truncata; sutura non crenulata; anfractus superstites 13, planiusculi, ultimus basi carinatus, antice breviter solutus; apertura subcircularis; peritrema breviter expansum.

Longitudo testæ truncatæ 16 mill., diam. 4 mill.

Columna interna lamellis 2 validis, superiori fortiori, lente descendentibus munita.

Habitat.—Cuba.

Cylindrella difficultosa Arango.

Testa rimata, cylindraceo-turrita, solidula, nitens, obsolete costulata, pallido-straminea; spira breviter truncata, sutura non crenulata; anfr. superstites 10, planiusculi, ultimus basi subcarinatus, non protractus; apertura ovalis; peritrema breviter et in margine sinistro minus expansum.

Longitudo testæ truncatæ 11 mill., diam. 2¾ mill.

Columna interna plicis 2 fortioribus ornata.

Differt a *Cyl. concreta* costulis, ultimo anfr. non soluto, columnæ internæ forma.

Habitat.—Cuba.

Cylindrella consanguinea Arango.

Differt a precedenti testa opaca, ultimo anfractu basi carinato et columna interna laminis 2 debilibus descendentibus munita.

Numerus anfractuum et longitudo testæ æqualis sunt illis speciei precedentis.

Habitat.—Cuba.

Cylindrella crassilabris Arango.

Testa rimata, subcylindrica, solidula, oblique remote lirata, fuscescens; spira breviter truncata; sutura subcrenulata; anfr. superstites 11, planiusculi, ultimus obsolete carinatus, breviter solutus; peritrema album, reflexum, præcipue in margine dextro.

Longitudo testæ truncatæ $12\frac{1}{2}$ mill., diam. 3 mill.

Columna interna inferne lamina una debili munito.

Habitat.—Cuba.

Cylindrella conferta Arango.

Testa rimata, subcylindrica, solidula, subconfertim striata, albida; spira breviter truncata; sutura impressa, non crenulata; anfr. superstites 10 planiusculi, ultimus obsolete carinatus, breviter solutus; apertura subcircularis; peritrema reflexiusculum.

Longitudo testæ truncatæ 10 mill., diam. $2\frac{1}{2}$ mill.

Columna interna simplex.

Habitat.—Cuba.

Cylindrella imparata Arango.

Testa non rimata, fusiformi-cylindracea, solidula, nitens, subconfertim obsolete striata, albida; spira regulariter attenuata, integra; sutura profunda, non crenulata; anfr. 17 planiusculi, ultimus subangulatus, breviter solutus; apertura subcircularis; peritrema reflexiusculum.

Longitudo testæ 16 mill., diam. $2\frac{1}{4}$ mill.

Columna interna lamellis 2 tenuibus circumvoluta.

Habitat.—Cuba.

Cylindrella propinqua Gundl.

Teste subrimata, cylindraceo-turrita, solidula, sublævigata, albida; spira plerumque truncata; sutura subcrenulata; anfr. superstites 11–12 planiusculi, ultimus basi non carinatus, antice striatus, breviter solutus, apertura subcircularis; peritrema reflexiusculum in margine dextro ob plicam interiorem plerumque subsinuatum.

Columna interna 3 plicata, plica superiori ampliori.

Propinqua *Cyl. cristallina* testa forma et sculptura, sed columna interiori omnino diversa.

Habitat.—Vinales in eodem loco cum *Cyl. capillacea.*

May 2.

The President, Dr. Leidy, in the chair.

Thirty-three persons present.

The death of Edw. Desor, a correspondent, was announced.

On Some Entozoa of Birds.—Prof. Leidy directed attention to some specimens presented by Joseph Willcox, recently collected by him in Florida. One of the specimens is the head of a Snake-bird, *Plotus anhinga*, with a worm in sight, lying upon the brain; while several other detached worms of the same kind lay at the bottom of the vial. The worm in its singular habitation was discovered by Prof. Wyman, in Florida, in 1861 and 1867, an account of which is given in the Proceedings of the Boston Society of Natural History, volume 12, 1868. Prof. Wyman had kindly presented Prof. Leidy with a specimen of the head of the Snake-bird, with the worms lying on the brain. This he had valued as a memento of his friend, but it had, unfortunately, been lost in the fire at Swarthmore College, last autumn. Prof. Wyman states that the parasites were found coiled on the back of the cerebellum between the arachnoid and pia mater. The number varied from two to six or eight, or even more. In nineteen birds they were detected in seventeen. Mr. Wilcox found the parasite in four out of six birds examined. In the present specimen of a head, a single worm is enclosed between the two laminæ of the dura mater over the position of the interval of the cerebrum and cerebellum. As the parasite appears not to have been named, it was suggested that the name of its discoverer should be associated with it under the name Filaria Wymani.

The accompanying four vials contain numbers of worms obtained from the stomachs of the Snake-bird, the Cormorant, *Graculus dilophus*, the White Pelican, *Pelecanus trachyrhynchus* and the Brown Pelican, *P. fuscus*. All prove to be of the same species, the *Ascaris spiculigera*. Specimens of these were also formerly obtained by Samuel Ashmead, in Florida, from the White Pelican, (Proc. Ac. Nat. Sci. 1858, 112). The same, likewise, have been submitted for examination by Dr. Elliott Coues, who procured them from the White Pelican, on the Red River of the North. See Birds of the North West, 1874, 587.

On a Coprolite and a Pebble resembling an Indian Hammer.—Prof. Leidy further exhibited a specimen which he had picked up from a pile of the irregular phosphatic nodules brought from Ashley River, South Carolina, for the manufacture of a fertilizer. The nodule, of several pounds weight, is a flattened oval black

mass, which he supposed to be the coprolite of a zeuglodont or cetacean.

He also exhibited a quartzite pebble, from a gravel bank in the University ground, West Philadelphia. It has a near resemblance to the stone hammers, with a groove around the middle, found in the ancient copper mines of Lake Superior. Notwithstanding this resemblance it is evidently a water-rolled pebble, the groove resulting from action on a softer stratum of the quartzite.

Historical Notes on the Arbor Vitæ.—Mr. THOMAS MEEHAN noted in detail the reasons given by various authors for the name *Arbor Vitæ* in connection with *Thuja occidentalis*—reasons unsatisfactory even to the authors who advanced them. He referred to the statement of Ray in his "Historia Plantarum" that the tree was first introduced from Canada to France and named *Arbre de Vie*, by King Francis the First. Francis died in 1547. The seeds from which these plants were raised could scarcely have been obtained in any other way than through Jacques Cartier's expedition, say in 1534, and we may, therefore, conclude that *Thuja occidentalis* was among the first, perhaps the first North American plant to become known in Europe. Parkman, in his "Pioneers of France," graphically describes the sufferings of Cartier's band during the winter of their encampment near the junction of the River Lairet with the St. Charles. Twenty-five died of scurvy and the rest were sick but two. A friendly Indian told him of an evergreen which they called "Annedda," a decoction of which was sovereign against the disease. In six days the sufferers had drunk a tree as large as a French oak, *Quercus ilex ?*, "the distemper relaxed its hold and health and hope began to revisit the hopeless company," (p. 195). This Annedda seems to have been identified with the White Spruce, *Abies alba*, and is, as I am informed by Dr. W. R. Gerard, the same as the Mohawk "Onnita," and the Onondaga "Onnetta." According to Rafinesque, the spruce beer of the Indians was made of the young tops and young leaves of this tree boiled together with maple sugar, and was one of their famous remedies for scurvy. Rafinesque also says that a decoction of the leaves of the Arbor Vitæ was an Indian remedy for scurvy and rheumatism; besides the leaves with bear's grease being used externally. Rafinesque, however, believes it was the White Spruce which saved the lives of Cartier's band, and if the "Annedda" of the Indians is really the White Spruce, the evidence through the statement made so soon after Cartier's expedition that the health-giving plant was the "Annedda," is strong. But spruce beer could not have been made in the winter season—the leaves only were used. There is no evidence that the White Spruce was known in Europe till towards the end of the 18th century. It is but natural that whatever the tree might have been, it was a veritable tree of life—an *Arbre de Vie*, to the voyagers. They would certainly make every effort to take with them to their native land

so valuable a tree. But we have no reason to believe that they attempted to introduce the White Spruce. There is, as we have seen, good reason to believe that Cartier took the *Thuja occidentalis* to Europe, and it is on record that his royal patron, a few years afterward, distributed the tree as the *Arbor Vitæ*, and, notwithstanding the seemingly positive evidence that the tree was the White Spruce, Mr. Meehan thought the *Thuja* had some ground for disputing the claim. At any rate, whatever may have been the real tree, he could not help suspecting that the name *Arbor Vitæ* had some relation to this touching episode in the history of the Cartier expedition.

May 9.

The President, Dr. Leidy, in the chair.

Twenty-seven persons present.

A paper, entitled "The Muscles of the Limbs of the Raccoon (*Procyon lotor*)" by Harrison Allen, M. D., was presented for publication.

The death of Chas. M. Wheatley, a member, was announced.

The death of Mr. Wm. S. Vaux having been announced, Dr. Ruschenberger read the following resumé of his services as an officer and member, and offered the appended resolutions, which were adopted:—

I sincerely regret to announce that Mr. William S. Vaux, the senior Vice-President of the Academy, died at his residence in the city, May 5, 1882, very near the close of the seventy-first year of his age. He was born May 19, 1811.

Mr. Vaux was elected a member of the Academy, March, 1834, and during more than forty-eight years served the Society effectually and generously. He was an Auditor thirty years, from December, 1856; a Curator forty-three years and four months, from December, 1838; a member of the Publication Committee, of which he was treasurer more than forty-one years, from December, 1840, and a Vice-President twenty years and four months, from December, 1860, excepting the year 1875.

His annual re-election to these important offices during all this time, implies that he discharged all his official duties satisfactorily to the Society.

During the construction of the hall, at the corner of Broad and

Sansom Streets, in which the Society held its first meeting, February 18, 1840, he was an active member of the Building Committee. He served in the same capacity when the building was extended in 1847, and in December, 1851, when it was determined to raise and improve the previously enlarged hall, a work which was completed December, 1855, he was elected a member of the Building Committee, and discharged all his duties efficiently.

In December, 1865, he was appointed a member of the Committee of Forty to solicit subscriptions for the erection of the hall now occupied by the Society, and in January, 1867, he was elected a member of the Board of Trustees of the Building Fund, and by it Treasurer of the Fund, and a member of the Building Committee, positions which he held when he died.

In all these building enterprises he was earnestly interested, gave liberally to all of them himself, and by his invitation and example influenced others to give. To the present building fund he contributed seven thousand dollars, the largest sum given by any individual.

Besides his gifts to the Building and other Funds, he contributed liberally to the museum, especially to the departments of mineralogy and ethnology, in which he was particularly interested, and also to the library.

This brief outline of his long and useful services and bounty to the Society is sufficient to indicate that the Academy has sustained a heavy loss by the death of Mr. Vaux. As a token of the Society's estimation of his worth, I submit the following resolutions:

Resolved, That the members of the Academy of Natural Sciences, of Philadelphia, deeply regret the death of the senior Vice-President, William S. Vaux, who was an experienced officer, a prudent adviser, and a steadfast and beneficent friend of the Society.

That in his death students of the natural sciences have lost a benevolent patron who contributed liberally to the means and facilities of study in possession of the institution.

That, as a message of condolence, a copy of these resolutions, attested by the President and Recording Secretary, be transmitted to his family.

MAY 16.

MR. MEEHAN, Vice-President, in the chair.

Twenty-eight persons present.

Influence of Heat on the separate Sexes of Flowers.—Referring to his former observations, in which it was noted that less heat was required to advance flowers than leaves, and still less for male than for female flowers, Mr. MEEHAN called attention to a communication in an English scientific periodical, showing that the same facts may exist in the English climate as in our own. It appears that this season, according to the correspondent of Hardwicke's *Science Gossip*, the male flowers of the hazel-nut, *Corylus Avellana*, had been brought forward and perfected, before any signs of the female flowers appeared.

Liquid Exudations in Akebia and Mahonia.—Mr. WM. M. CANBY called attention to the exudation of moisture from the tips of the leaflets in *Akebia quinata*, a plant twining over a trellis near his porch dripped moisture enough to make the floor look as if sprinkled. An examination of the leaflets by Prof. Rothrock disclosed an arrangement of the tissue at the apex of each leaflet, evidently adapted to such an exudation. Mr. MEEHAN had been led by Mr. Canby's observations to watch closely a plant growing over a trellis on his house, confirming Mr. Canby's experience. The liquid globules on each leaflet were of the size of ordinary pin-heads. Their appearance was not constant, nor did there appear any regular period for the emission of the fluid. It was as likely to appear when the atmosphere was dry as when moist, or at midday as at evenings. The close relationship of *Lardizabalaceæ* to which *Akebia* belonged, to *Berberidaceæ*, led him to examine *Mahonia aquifolia*, flowering at the same time, and he found in many flowers just before expansion a small globule at the apex of the pistil, and in the same bud globules pressing through the divisions of the corolla. These would collect as they flowed out, and globules as large as peas, and of a quicksilvery hue, were not unfrequently found among the mass of flowers forming the densely fasciculated head. The fluid was of a viscid character. Only a few flowers exhibited the exudation at each examination, and he was led to believe that the flow in each flower was soon over. In *Thuja* there was also this sudden appearance of a small globule at the open mouth of the naked ovule, and which seemed to disappear very soon after its formation. In a large number of flowers examined only a few with globules at the apex were found at each examination. The liquid in this case did not disappear by evaporation, but seemed to be absorbed by

the nucleus. Sachs suggests a use for the exudation in coniferæ. The pollen is brought to the globule by the winds, and, as the moisture sinks within the vesicle, the pollen grain is carried to the nucleus, and fertilization is effected by actual contact. It would be extremely difficult for the pollen to affect the nucleus in *Thuja*, and some other coniferæ, as in ordinary flowers, in the absence of this liquid exudation.

Individual Variation in Species.—Mr. MEEHAN remarked on the prevailing tendency to look on striking variations in species as the result of hybridization. To his mind there were few species that did not exhibit a wide range of individual variation in some particulars, if we had good opportunities to look for them. He exhibited a series of cones taken from different trees of *Pinus rigida*, all gathered in Atlantic County, New Jersey, and pointed out how they each varied. Some double in length of their width, others conoid with a flattish base, others perfectly globular being rounded at both ends. Some had very narrow scales, and some half as broad as long, and again, some reflexed to a wonderful extent in drying, while some with the broad scales would only open to a very slight degree. Some trees would have cones several inches in length and width, while others had cones barely an inch long, and yet with perfect seeds. The cones were in a regularly graded order, the typical *P. rigida* at one end, at the other the cone would scarcely be distinguished from *P. serotina*. The intermediates then taken away from the central one left it to appear as a "hybrid" between the two.

Mr. Meehan said there was evidently a law of nature providing for individual variation. Whether this law of individual variation is distinct from that law of variation which resulted in the evolution of distinct species, might well be a question. It was at least well to recognize the two classes of variation for practical purposes.

Prof. Heilprin, Rev. Dr. McCook and Mr. Redfield discussed points suggested by Mr. Meehan's communication.

The following was ordered to be printed :—

THE MUSCLES OF THE LIMBS OF THE RACCOON (PROCYON LOTOR).

BY HARRISON ALLEN, M. D.

The genus *Procyon* is known to be one of the most ancient as well as one of the most generalized of the carnivora. The study of such a form when made in comparison with the more recent and more specialized genera, presents many features of interest. The following account of the muscles of the limbs has been undertaken with a view of ascertaining more especially what differences exist between these muscles and those of *Felis domesticus*,[1] and of man. Occasionally references to *Nasua fusca* were also made. Many variations in the human subject were found to correspond to the normal arrangement in *Procyon*. Since the subjects of nerve and muscle are intimately associated, not only anatomically but physiologically, it is stated from which nerve trunk each muscle derived its supply.

The material for dissection consisted of two adult females, obtained through the courtesy of Prof. Alexander Agassiz, of the Museum of Comparative Zoology, Cambridge, and of Mr. Arthur E. Brown, Superintendent of the Zoological Garden, Philadelphia.

THE MUSCLES OF THE SUPERIOR EXTREMITY.

(a) *Extrinsic Set.*

The Cephalo-humeral Muscle is a broad, flat, fleshy muscle arising from the occiput at its crest for a distance of eight lines, and from the ligamentum nuchæ for one inch and a quarter, that is to say, for a distance equal to one-half the length of the dorsum of the neck. The muscle passes obliquely downward over the front of the shoulder, and is narrowed gradually to be inserted by fleshy fibres into the linear ridge on the anterior surface of the humerus. It blends with the tendon of the Pectoralis Secundus —and indeed may be said to be inserted by fleshy fibres *upon* the lower part of the fibrous portion of this muscle. A tendinous inscription passes through the muscle opposite the head of the humerus. Connected with the under surface of this inscription

[1] When the domestic cat is referred to in the text the word "Felis" is used.

is a stout fascia, which passes over the head of the humerus and is lost on the acromion and the metacromion. This fascia embraces the lower third of the Levator Anguli Scapulæ and appears slightly at the lateral aspect of the Cephalo-humeral muscle.

The rudimentary clavicle is in close relation with this muscle. The under surface of the bone is occupied by a stout membrane which passes downward and forward to the axilla, where it is lost on the fascia covering the Subscapularis muscle. This membrane seems to support the Supraspinatus muscle, and separates the nerves of the arm from those of the region of the Scapula.

The Trapezius.—The upper division arises from the occiput at the median third of the superior curved line, and from the ligamentum nuchæ at its lower half. It is inserted upon the border of the spine of the scapula for its anterior three-fourths, and is continuous by an aponeurosis with the lower division over the remaining fourth. The lower division arises from the last cervical and the nine upper dorsal spinous processes, and is inserted directly upon the middle two fourths of the scapular spine, at the lower border, and indirectly (by reason of a union with the Infraspinatus aponeurosis) upon the remaining half of the spine. It is supplied by branches of the third and the fourth dorsal nerves.

The Levator Claviculæ arises from the occiput beneath the origin of the Splenius, passes downward along the side of the neck to be inserted upon the under surface of the tendinous inscription of the Cephalo-humeral muscle for its entire length, as well as upon the clavicle for its entire length. Its nerve-supply is by branches of the first trunk of the brachial plexus.

The Levator Anguli Scapulæ arises from the anterior half of the corresponding side of the body of the axis. It passes down the side of the neck to be inserted on the acromion, where its fibres are continuous with those of the Trapezius. It is supplied by branches from the first trunk of the brachial plexus.

The muscles usually called Trapezius and Levator Claviculæ, in *Procyon* form parts of a single muscle, each of which bears to the whole a relation somewhat analogous to that which the different parts of the Pectoralis muscle bear to one another. As in the Pectoralis, they all influence the movement of the humerus, and like it many of the fibres are not inserted directly into the humerus, but indirectly through the advent of membranous, fibrous extensions.

But in addition to this the Levator Scapulæ and at least one part of the Trapezius, are inserted into the spine of the scapula, while the Levator Anguli Scapulæ, so called, is inserted into the acromion, so that the group is even less specialized than is the Pectoralis group, inasmuch as it is inserted into two bones of the anterior extremity, the scapula and the humerus. The Levator Anguli Scapulæ becomes superficial between the Cephalo-humeral and the scapular fibres of the Trapezius, while the Levator Claviculæ lies deep-seated beneath the Cephalo-humeral, and while being inserted at the tendinous inscription of the latter is in close relation to a thin fascial expansion that lies directly over the shoulder-joint. The Levator Anguli Scapulæ and the Cephalo-humeral muscles in their turn terminate in part upon an aponeurosis which passes over the Deltoid muscle and is lost on the Infraspinatus, the Teres Major and the Triceps muscles, and with which the epitrochlear slip of the Latissimus Dorsi is in intimate association.

This single great muscle, therefore, can draw the scapula and the humerus forward; through its traction on the clavicle make tense the subscapular fascia; through the fibres of the Levator Anguli Scapulæ make tense the sheath of the muscles of the extensor surface of the arm, and through the agency of the dorso-epitrochlear slip of the Latissimus Dorsi, the fascia of the rest of the upper extremity.

The Rhomboideus arises tendinously from the occiput seven lines from the median line. It arises, also, from the ligamentum nuchæ its entire length, and from the five upper dorsal spines. It is inserted with the Serratus Magnus at the upper border of the scapula for nine lines. The posterior third of the fibres at the vertebral border are coarser than the remainder. Some of the fibres pass upward upon the dorsum of the scapula. It is supplied by branches of the cervical plexus at the middle of the lateral border.

The Serratus Magnus arises from the transverse processes of the fourth, the fifth, the sixth and the seventh cervical vertebræ and from the first seven ribs. It is inserted into the vertebral border of the scapula its entire length.[1] Its nerve-supply is from the long thoracic.

[1] The vertebral border is separable from the anterior by being twice its thickness, and in being limited anteriorly by the triangular base of the spine.

The Latissimus Dorsi arises from all the dorsal spines, from the vertebral aponeurosis, and from the twelfth, the thirteenth and the fourteenth ribs. It is inserted into a linear rugosity on the shaft of the humerus, placed to the median side of the deltoid ridge, and behind the tendon of the endo-pectoral portion of the Pectoral muscle. The dorso-epitrochlear slip equals in width the Latissimus at its insertion. It arises by a broad origin from the Latissimus, just prior to the formation of its tendon, and is tendinously inserted upon the median margin of the olecranon for its entire length. The internal dorso-epitrochlear slip seen in *Felis* is here absent. A long, slender slip of the ventral border of the Latissimus is inserted upon the central axillary tendon. It is supplied by numerous branches from the intercostal nerves, and at the axilla by a branch of the brachial plexus.

The *Pectoralis Major* muscle is divided into two portions. That portion which is superficial at the ventro-anterior aspect of the thorax (Ecto-pectoral of Wilder) arises from the sternum, a little more than one-half its length, also from an intermuscular septum between it and the muscle of the opposite side, extending thence four lines from the sternum along the median line of the neck. It is inserted into the deltoid ridge of the humerus, and into the triangular space lying between this ridge and the head of the bone. At its distal end this muscle is inserted with the Cephalo-humeral. This portion is fleshy throughout, except at the under surface at its insertion. It represents the *P. primus*, *P. secundus* and *P. quintus* of other mammals. An imperfect attempt is made at the separation of the *P. quintus*, but none of the *P. primus*.

That portion which is deep-seated at the ventro-anterior aspect of the thorax (Endo-pectoral of Wilder) embraces a broad and imperfectly differentiated sheet of fibres pertaining to the Panniculus, and to a sternal mass. The two divisions fuse intimately, so that they need not be separately described. They together represent the *P. quartus* of other mammals.

The usual plan of description of a muscle may here with propriety be reversed, and the insertion described before the origin. Lying beneath the fibres of insertion of the superficial portion of the muscle is a thin fibrous sheet that is attached to the deltoid ridge, to the median side of the insertion of the superficial portion. It extends from this line upwards over the scapular tendon of the Biceps, and is lost in the capsule of the

shoulder-joint and in the fascia over the coracoid process, as well as that beneath the Subscapular muscle. It passes downward beyond the ridge, where it receives a few fibres from the superficial portion and is lost in the antebrachial fascia.

It is nearly as broad as long, and in every part is distinct from the superficial portion of the Pectoral. In this description of the Pectoral group the membrane will receive the name of the *fibrous membrane of insertion or the central axillary tendon.*

The pannicular division of the deep mass arises as a broad sheet from the superficial fascia of the trunk, its dorsal portion from the sacrum to over the scapula, and the ventral portion from over the middle line of the thorax. Its fascicles converge toward the axilla, some of them fusing with the lower margin of the sternal sheet, and others ending on the posterior margin of the fibrous membrane of insertion. Others yet are inserted about the middle of the under (ventral) border of this membrane of insertion.—The sternal sheet arises from the sternum at the lower border of the superficial portion, which overlaps it, to the base of the ensiform cartilage, as well as from the subcutaneous tissue at the præcordium. It is a ribbon-shaped, fleshy muscle, and ends on the membrane of insertion by distinct fibres, and is continued over it to the deltoid ridge. These fibres are free from the membrane at the upper half of the line of insertion. Placed between the pannicular and the sternal sheets, a third fascicle is received, viz., a marginal slip from the Latissimus Dorsi.

Arising from the lower margin of the membrane of insertion, is the median dorso-epitrochlear slip. It fuses with the Trapezius at its distal half. It is inserted on the median margin of the olecranon, and contributes to the formation of the antebrachial fascia.

Muscular fibres thus approach the aponeurosis of insertion of the deep portion of the pectoral from the skin of the back and abdomen, from the sternum and from the Latissimus Dorsi. The lower margin of the membrane receives more fibres than the remaining portions, while the proximal parts receive none. The sternal sheet at its upper half tends to be specialized from the membrane, and throughout can be said to adduct the humerus. The pannicular sheet, together with the Latissimus slip, may be described as a tensor of the sheath of the Biceps and of the capsule of the shoulder-joint. The median dorso-epitrochlear slip protects the nerves of the upper arm.

The Pectoralis Minor (P. Tertius) arises from the second to the fifth costal cartilages inclusive, to the outer side of the sternum, and is inserted tendinously into the bicipital border of the great tuberosity of the humerus. It here forms the anterior part of the capsule, and is united with the Supraspinatus muscle. This muscle has been described in human anatomy as being inserted on the Supraspinatus, or as being continuous with it.

In *Procyon* no portion of either the Pectoralis Major or Pectoralis Secundus is inserted into the antebrachial fascia. The Pectorals are supplied by branches of the brachial plexus and of the intercostal nerves.

(*b*) *Intrinsic Set.*

The Supraspinatus and the Infraspinatus Muscles do not present sufficient points of difference as compared with the same muscles in other mammals to deserve special description. The Supraspinatus is, in great part, bilaminated, the interlaminate space tending to open forward. The origin of the Deltoid and the insertion of the Trapezius largely conceal the Infraspinatus. The nerves are received from the suprascapular nerve.

The Subscapularis is composed of three main sub-divisions. The most anterior of these arises from the anterior border of the scapula for its entire length, and the intermuscular septum between it and the Supraspinatus muscle. It is inserted into the humerus. It yields fibres of origin to the Coraco-Brachialis. Its fibres are parallel with those of the last-named muscle, and may be said to be physiologically in continuity with them. The tendons of the remaining subdivisions of the Subscapularis underlie the tendon of the first division.

The muscle is entirely free from insertion into the delicate capsule of the shoulder-joint. It is supplied by three nerves, each of which is a branch of the brachial plexus.

The Teres Major arises from the aponeurosis of the Infraspinatus, from the lower margin of the Subscapularis near the scapular angle, as well as from a small portion of the scapula at the upper end of the vertebral border. The muscle is tendinous where it overlies the humerus and is inserted beneath the Pectoralis Secundus, on the median side of the bicipital groove.

Directly back of the origin of the Teres Major lies the insertion of the Rhomboideus. The muscle is supplied by a branch of the brachial plexus.

Teres Minor.—This muscle is so intimately fused with the Infraspinatus as not to demand a sèparate description.

Deltoid.—The fascicle from the fascia over the Infraspinatus muscle joins the fascicle from the acromion at the distal half of the latter. The two fascicles thence continue as a single muscle to the humerus. The nerve-supply, which is from the anterior circumflex, is abundant. The most important fascicle would appear to be from the Infraspinatus fascia. The tendon receives the terminal fascicle on its outer surface, and its tendon of insertion lies in contact with the tendon of origin of the outer head of the Triceps.

The Triceps possesses four heads. The first arises from the scapula, as in man, by a thin tendon as broad as the muscular belly, and is inserted into the tip of the olecranon.

The second, or lateral humeral portion, from the lateral aspect of the neck of the humerus by a flat, thick tendon, one-fourth the greatest width of the belly. It is inserted into the tendon of the preceding, and into the olecranon on the lateral border, and into the ulna at its upper fourth, where it becomes continuous with the Profound Flexor as it arises from the posterior edge of the ulna. The second portion receives an accession of muscular fibres from the posterior median portion of the neck of the humerus. It joins the belly half way down the humerus.—The third portion arises by a flat, thin tendon from a median surface upon the humerus at its upper third. It merges in part with the small Coraco-Brachialis. It also arises from a distinct broad surface upon the border of the humerus between the epitrochlea and the upper border of the epitrochlear foramen. This slip is inserted into the olecranon and is merged with the origin of the Flexor Carpi Ulnaris. This is quite a frequent human anomaly.

The scapular head of the Triceps, with the internal humeral fasciculi, form parts of a single bilateral laminated sheet. The dorsal portion of this sheet is aponeurotic at and near the olecranon, and is continuous with the antebrachial fascia. The external humeral head from the proximal end is bilaminate one-half its entire length.[1]

[1] In *Felis* the internal humeral head is distinct from the scapular, and the bilaminate arrangement is in all parts of the muscle less evident than in *Procyon*.

Nerve-Supply.—The nerves of the Triceps enter the interlaminate spaces, there being one nerve for the scapular and the internal humeral heads, and a second for the external humeral head.

It is worthy of note that in *Procyon* the Triceps is inserted not only *behind* the elbow, but, by an aponeurosis, into the ulna in *front* of the elbow. Since the ulna cannot move and the insertion is chiefly on the lateral border, the bone, after being extended, is with the humerus rotated *inward* at the shoulder. In a word, the Triceps is an inward rotator of the entire extremity.

Anconeus arises upon the posterior surface of the humerus from the triangular space at the lower half of the bone. Its firmest attachment is on the lateral border. It also arises from the epicondyle, one line below the tip, directly to the outer side of the Extensor Carpi Ulnaris. Its fibres are inserted into the entire lateral surface of the olecranon, and the whole muscle keeps well to the lateral half of the joint. Nerve-supply: The long nerve to the Anconeus sends a branch to the external humeral head of the Triceps.

Biceps Cubiti arises by a single stout head from the coracoid process of the scapula. The muscle presents on the proximal half of both its anterior and posterior aspects a thin, glistening, fibrous surface, but at the distal half it is free from superficial fibrous tissue. The tendon of insertion is but one-third the length of the tendon of origin. It is inserted into the tubercle of the radius. This entire muscle is composed of a sheet which is so folded upon itself as to produce the effect of a pair of laminæ, joined at the lateral border. Three separate branches from the brachial plexus enter the muscle in the interlaminate space, as well as a fourth, which, indeed, supplies the muscle, but since it lies in the position of the musculo-cutaneous trunk of *Felis* and most mammals, may be identified with this nerve. It does not, however, pierce either this muscle or the Coraco-Brachialis, as in man.

Coraco-Brachialis arises from the coracoid process by a narrow tendon which winds across the ventral surface of the tendon of the Subscapularis muscle. The muscle increases in width as it descends, and is inserted by fleshy fibres into the humerus distally to the tendon of the Latissimus Dorsi. The fibres of insertion are in close connection with the fibres of origin of the median head of the Triceps muscle. It receives a long slender nerve from the subscapular group of nerves from the brachial plexus.

Brachialis Anticus arises by penniform fleshy fasciculi from the entire lateral surface of the humerus. It lies in juxtaposition with the Biceps. No fibres whatever arise from the front or median surface. The upper fibres are nearly vertical and the lower nearly horizontal. Its tendon passes beneath that of the Biceps, and is inserted upon the median surface of the ulna, below the elbow-joint. The Brachialis Anticus keeps the ulna in contact with the trochlea, while the Biceps flexes the forearm. It also assists the Biceps in this movement and keeps the ulna within the tract of flexion.

The Brachialis does not arise from all the surface of the humerus which it covers; the muscular fibres are connected with the bone along the margins of the muscle only. The slips extend the entire length of the median, but for a shorter distance on the lateral margin. It is inserted upon a smooth surface on the median aspect of the ulna below the coronoid process. It is thus seen that this is chiefly a lateral muscle as related to the axis of the humerus, and by its insertion on the innermost and posterior portions of the two bones of the forearm, pursues an oblique direction as a whole, from the origin to the insertion. A variation in man consists in the union of this muscle with the Supinator Longus.

Pronator Radii Teres.—This muscle arises from the front of the epitrochlea, a surface which it exclusively occupies, the remaining flexors lying below it. It is aponeurotic in origin, inferiorly, and is wholly tendinous at its insertion. The distal border of the tendon reaches the middle of the shaft of the bone. The Pronator is to the radius what the Brachialis Anticus is to the ulna. The nerve-supply is derived from a small branch of the median nerve.

Flexor Carpi Radialis arises in common with the Flexor Sublimis Digitorum, and with the fine fasciculi with which it is intimately fused. It is inserted into the base of the second metacarpal bone, beneath the origin of the Metacarpo-Phalangeal Flexors. It receives its nerve-supply from the median nerve.

Flexor Carpi Ulnaris arises by two heads; the first arises from the depression on the median side of the olecranon, where it is continuous with the aponeurotic slip from the median humeral head of the Triceps, and is inserted by a long and narrow tendon into

the pisiform bone. The second head arises from the epitrochlea of the humerus, passes down parallel to the foregoing, and is inserted into the pisiform bone to the median side of the first portion. The second head also arises from the epitrochlea in common with the Flexor Sublimis Digitorum. The muscle lies entirely upon the Flexor Profundus, and does not touch the ulna. The nerve-supply of the first head is very minute, and confined to the extreme proximal end of the belly. That for the second head is larger, branches being received from the ulnar nerve at three different points along the proximal half of the belly.

It is evident that in *Procyon* the two divisions of the Flexor Carpi Ulnaris usually described are equivalent to distinct muscles. Unlike the arrangement seen in *Felis*, no attempt at fusion between the ulnar and humeral heads is seen, while the tendency for the humeral head to fuse with the superficial flexor is seen in both forms, though to a much less degree in *Procyon* than in *Felis*.[1]

Palmaris Longus.—The Palmaris Longus was double in one specimen, both portions arising in common with the Flexor Sublimis Digitorum.[2] In the other specimen it was found to be single, and the nerve-supply little or none.

Flexor Sublimis Digitorum.—This muscle arises from the epitrochlea. It soon divides into two portions. One of these passes without division to the Flexor Profundus Digitorum; the other, the main muscle, divides into two parts, one of which is inserted into the first and the second toes, and the other on the third and the fourth toes. The slips for the first and the second toes divide into two slips, one for each side of the sheath of the deep flexor at the first phalanx. In one specimen, the first toe received no slip.

The nerve-supply is from a small branch of the median nerve.

[1] The connection between the insertion of the muscle and the fifth metacarpal bone is much less decided than between the Extensor Carpi Ulnaris and the same bone. Such connection has been omitted as part of the essential description of the muscle.

[2] The Extensors lie successively along a ridge (supracondyloid ridge). The flexors are collected in a "bunch" at a process (not a ridge), the Pronator Radii Teres excepted. This muscle lies by itself above and in front of the "bunch."

The failure of the superficial flexor to support the sheaths of the third and fourth digits, may occur as an anomaly in man.[1]

The Flexor Profundus Digitorum arises in a penniform manner from the ulna, as follows: 1st, from the concavity on the median surface of the olecranon; 2d, from the posterior border of the ulna at the upper third; and 3d, from the median surface of the ulna at its middle third, near the distal end. The second portion derives some fibres from the membranous expanse of the Triceps on the lateral surface of the olecranon, and the intermuscular septum between it and the Extensor Indicis. Its tendons pass to the four outer toes. The under part of the tendon at the wrist is smooth.

Macalister[2] does not mention the union with the Triceps tendon. This might be found to vary in man. The nerve-supply of this muscle is from the median nerve.

The Flexor Longus Pollicis is composed of two separate portions, a superficial and a deep. The superficial portion arises in common with the Flexor Carpi Radialis from the epitrochlea. It is fleshy for the upper third of its course, and joins the Flexor Profundus Digitorum at the lower border of the annular ligament. Just prior to the formation of the tendon, muscular slips join the bellies of the Flexor Sublimis Digitorum and the Flexor Profundus Digitorum. Below the annular ligament the tendon for the thumb leaves the Profundus and passes to the second phalanx. From this tendon arises a Lumbrical muscle. A large slip passes from the fleshy portion to the tendon of the deep flexor just above the annular ligament.

The deep slip is penniform in character. It arises from the radius at its upper third, and joins the conjoined tendon at the upper border of the annular ligament. The last-named slip is evidently homologous with the anthropodean muscle of the same name. The nerve-supply is from the median.

It is interesting to note that the variations of this muscle in the human subject include in essential features the above arrangement. Mr. Carver[3] describes as arising partly from the Profundus

[1] In *Nasua fuscus* the slips of union between the superficial and the deep flexor are *three* in number, and are inserted on the conjoined tendon above the annular ligament. The union of the Sublimis with the Profundus occurs below the tendon.

[2] Trans. Royal Irish Acad., xv, 1872.

[3] Jour. of Anat. and Phys., iii, 260.

and partly from the Sublimis, a small muscle which became tendinous, and, just above the annular ligament, divided into two portions, one for the Flexor Pollicis, and one for the Profundus slip for the index finger. Excepting the slips from the Sublimis, this follows the plan in *Procyon*, the division in the latter occurring higher up. The lumbrical slip also is repeated as an anomaly in human myology (Wood and Macalister). The origin of the muscle from the epitrochlea, instead of from the radius, is a common human variation. The origin in common with the Flexor Carpi Radialis is, so far as I know, not repeated in man.

The Extensores Carpi Radiales Longior et Brevior, are as in man; the Brevior is the stronger of the two, and is confluent above with the Extensor Communis Digitorum.

It is supplied by the posterior muscular branch of the musculo-spiral nerve before it pierces the Supinator Brevis. The nerves spread on the under surface by short, single trunks at the proximal end.

The Supinator Brevis arises from the orbicular ligament by a narrow tendon, and is inserted upon the upper third of the radius. This is the arrangement in Gruber's Tensor Ligamentum Orbicularis Anterior of Man. He found it in fifteen cases in one hundred. This muscle is pierced by the posterior muscular branch of the musculo-spiral nerve, and receives from it its nerve-supply.

The Supinator Longus, much narrower than in *Felis*, arises muscularly from the upper end of the upper third of the Supracondyloid ridge, and is inserted tendinously upon the distal end of the radius. Its sparse nerve-supply is confined to a single small branch to the proximal end, derived from the posterior muscular branch of the musculo-spiral prior to its piercing the Supinator Brevis muscle.

The Extensor Communis Digitorum arises from the supracondyloid ridge between the Extensor Carpi Radialis Brevior, and the Extensor Minimi Digiti, and is in common therewith. It soon, however, separates from them, and, forming a tendon, divides beneath the annular ligament into four small tendons. These reunite upon the dorsum of the carpus to again separate and pass to the dorsal surface of the first phalanx of each toe. It is supplied from the posterior branch of the musculo-spiral nerve.

Extensor Carpi Ulnaris arises from the external condyle of

the humerus by a relatively broad tendon. The flat, weak belly terminates obliquely on a broad, stout tendon of insertion, which is attached to the lateral border of the pisiform bone at the base of the fifth metacarpal bone. The connection with the pisiform bone is more exact than in *Felis*, but in addition to fixing the pisiform the tendon seems to make tense the dorsal aponeurosis. It is largely ligamentous in action, and probably protects both the elbow and the wrist-joints.

Nerve-Supply.—Nerves are received on the median border by three distinct trunks. They are thus more numerous than those to the flexors of the carpus and of the fingers. The nerves arise from a little close network which also supplies the Extensor Communis Digitorum, and is derived from a branch of the musculo-spiral, which penetrates the Supinator Brevis.

Extensor Ossi Metacarpi Pollicis occupies the interval between the ulna and the radius, and arises from the proximal end of the distal half of the latter, and along the shaft of the former from the side of the olecranon to near the distal extremity. The muscle below the oblique ligament is penniform, the long oblique ulnar fibres joining the medianly-placed tendon, which winds around the distal third of the radius, lying in the pronounced groove at the wrist-joint, and is inserted into the median aspect of the proximal end of the first metacarpal bone. In one specimen the muscle was bi-penniform, the muscular fibres arising from the radius being inserted into the tendon to the median side. The weak nerve-supply of this muscle is derived from the posterior branch of the musculo-spiral, the nerves entering upon its upper free surface.

The Extensor Minimi Digiti arises from the supracondyloid ridge to the outer side of the preceding muscle, which it resembles in its general features, also from the orbicular and external lateral ligaments of the elbow-joint, and passes beneath the annular ligament by a distinct sheath, viz., over the distal end of the ulna. The tendons do not reunite after the first separation, but are inserted upon the lateral surfaces of the first phalanges of the three outer toes. The slip to the fifth toe is not distinct from the rest of the muscle as in *Felis*.[1]

[1] In *Nasua fuscus* the E. M. Digiti tends to unite with the Extensor Communis Digitorum, but subsequently separates therefrom before insertion.

The Extensor Indicis arises from the lateral aspect of the ulna just below the olecranon, and, for a slight distance, from the septum between it and the Flexor Profundus. Its tendon passes parallel to the ulna, and reaches the manus by running beneath the tendon of the Extensor Communis Digitorum beneath the annular ligament. The tendinous slips are inserted upon the first, the second and third fingers to the lateral side beneath the three tendons of the Extensor Communis. The muscle receives a tendinous slip from the Extensor Minimi Digiti, and is thus an abductor, and assists the Extensor Carpi Ulnaris and the Extensor Minimi Digiti. It receives two branches from the posterior muscular branch of the musculo-spiral nerve.

Pronator Quadratus extends from the middle of the forearm to the proximal border of the distal epiphysis of the radius and of the ulna. It is broader toward the wrist than toward the elbow where its fibres are pale and inconspicuous. The radial fibres are not concealed by the stout aponeurosis so conspicuous in *Felis*. The nerve-supply is from a deep branch of the interosseous.

Palmaris Brevis arises as a single slip from the annular ligament and is lost over the base of the fifth toe.

The Intrinsic Muscles of the Manus embrace the following:—

The Opponens Hallucis.—This insignificant fascicle arises from the fibrous tissue over the sheath of the Flexor Carpi Radialis, and is inserted into the proximal end of the first metacarpal bone. It is upon the same plane with some of the fibres of origin of the first Metacarpo-Phalangeal Flexor.

The Palmar Interossei.—These muscles are three in number. The first and the third, passing respectively to the first phalanx of the hallux and the first phalanx of the annularis, are twice as broad as the second, which goes to the first phalanx of the index finger. These all arise from the fibrous tissue over the proximal ends of the metacarpal bones.

Opponens Minimi Digiti arises in common with these muscles to the lateral aspect, and is fused at its proximal third with the third muscle. It is inserted into the distal end of the metacarpal bone.

Flexor Brevis Minimi Digiti arises from the annular ligament and is inserted into the sheath of the Flexor Profundus Digitorum by a structure exactly similar to that found in the pes.

Abductor Minimi Digiti arises from the pisiform bone and ends by a long aponeurotic tendon upon the sheath of the first phalanx of the fifth toe in its lateral aspect. The muscle receives an accessory slip from the connective tissue beneath the deep flexor.

The Metacarpo-Phalangeal Flexors.—Each arises from the metacarpal bone of the corresponding toe and is inserted into the sesamoid bone of the metacarpo-phalangeal joint. The fifth toe alone possesses the Dorsal Interosseus, and even in this instance the muscle is in great part fused with the flexor muscle. For the remaining toes the Dorsal Interosseus is undifferentiated, yet latero-dorsal slips of tendon connect those parts of the flexor muscles seen from above in the intercarpal spaces, with the sides of the sheaths of the digits. As in the pes, so in the manus the divisions between the two portions of the flexors are more pronounced in the hallux and annularis than in the remaining toes.[1]

The Muscles of the Inferior Extremity.

(a) *Extrinsic Set.*

Quadratus Lumborum.—This muscle has not been differentiated from the vertebral series in *Procyon*. On the ventral aspect a flat slip is seen arising from the second lumbar vertebra on a line with the origin of the transverse abdominal muscle. It passes upward and outward to be inserted on the last rib at about its middle. A second flat slip, lying a little below the preceding, and on a deeper plane, appears to be a cleavage from the internal oblique abdominal muscle. It arises from the ventral aspect of the Longissimus Dorsi, and is inserted into the last rib at its

[1] The Lumbricales, Palmar and Dorsal Interossei muscles of *Procyon* may be described as inserted into the sheath of the digit. In the manus of the Macaque this was seen to be the case also. It will be remembered that in human anatomy the Dorsal Interossei are described as having their insertions into the extensor tendons of the digits as well as into the base of the first phalanx of each finger. It is probable that the simplest expressions of these muscles in mammals are as *tensors of the sheaths* of the digits on the dorsal and lateral surfaces, and that their connection with the tendons of the extensors of the fingers is not an essential one. Indeed the extensor tendons themselves may be said to end upon the same sheath, the latter being described as enveloping each digit like the fingerstall of a glove. It is free everywhere between the interphalangeal joints above and at the sides, but is closely incorporated with the capsules of the last-named joints as well as with the sheaths of the flexor tendons.

ventral third. These two slips are, perhaps, representative of the costal fibres of the Quadratus. The ilio-vertebral fibres are represented by an imperfectly differentiated slip, extending from the ventral aspect of the iliac crest to the transverse processes of the last lumbar vertebra.

The Longissimus Dorsi is very conspicuous from the ventral aspect of the trunk, and doubtless affords the generalized mass from which the Quadratus Lumborum of human anatomy has been evolved.[1]

Psoas Minor arises from the ventral surfaces of the bodies of the first three lumbar vertebræ, and is fused with the Psoas Magnus. It is inserted by a broad, glistening aponeurosis into a pronounced ridge of the ilium, directly above the ilio-pectineal eminence.

Psoas Magnus arises from the bodies of the third, fourth and fifth lumbar vertebræ, and the anterior surface of the corresponding transverse processes. After being joined by the Iliacus Internus, its tendon is inserted, after winding around the neck of the femur, into the trochanter minor. Both the Psoas muscles are perforated by a branch of the lumbar plexus, the Psoas Magnus being more particularly supplied by a number of short filaments from the anterior crural nerve.

Iliacus Internus arises by a long slip the entire length of the iliac fossa, and by a broad sheet of fibres extending across the venter of the ischium below the attachment of the ilio-lumbar fascicle of the Quadratus Lumborum, and also by a thin slip directly above the origin of the Rectus Femoris. The muscle is not confined to the pelvis. The anterior margin overlies the origin of the Tensor Vaginæ Femoris and of the Rectus Femoris. It is fused with the Psoas Magnus at the upper margin of the acetabulum.

The Psoas Magnus and the Psoas Minor unite with the vertebral mass, from which they are imperfectly differentiated, in forming a powerful vertebral flexor, which can be traced upward behind the pleura as far as the body of the ninth dorsal vertebra. The Psoas Magnus can be divided into several imperfectly defined laminæ, the interspaces between which carry the branches of the lumbar and sacral plexuses.

[1] The muscle last named is here included, for while acknowledged to be a trunkal muscle it has important relations to the innominate bone.

Gluteus Maximus.—The Gluteus Maximus arises from the ilium, the vertebral aponeurosis, the lateral margin of the sacrum and the transverse process of the first caudal vertebra. The iliac origin is membranous, its under surface being in intimate union with the Gluteus Medius. The sacral origin is musculo-tendinous, as is that from the first caudal vertebra. The common sheet formed by the union of the two surfaces last named, affords origin for a slip of the Lateral Caudal muscle. The margins of the Gluteus are muscular throughout their entire length, but the muscle becomes tendinous as it overlies the trochanter major. It is in close connection if not continuous with the upper margin of the Quadratus Femoris at its insertion. The Gluteus Maximus is inserted into the third trochanter, which lies rather upon the anterior than upon the lateral surface of the femur, and by a well-defined slip into the fascia lata.

The anterior border of the Gluteus Maximus is inseparable from the corresponding border of the Gluteus Minimus.

The nerve-supply of the Gluteus Maximus is derived from branches piercing both the Gluteus Medius and the Gluteus Minimus near their anterior borders: the longest branch (arriving from the great sciatic nerve) lying on the under surface of the muscle, corresponding pretty accurately to that portion arising from the sacrum and the first caudal vertebra. In addition to these nerves the muscle receives several branches of the Inferior Gluteal nerve. The entire muscle easily resolves itself into two portions, which, however, cannot be separated by the knife. The anterior portion, of iliac origin, receives nerves by distinct Gluteal branches, and becoming fused with the Gluteus Medius, rotates the femur inward; while the posterior portion arises entirely from the sacrum and first caudal vertebra, fuses with the Tenuissimus, and, receiving the distinct and very long gluteal branch already mentioned, rotates the femur outward. The last-named muscular portion is extrinsic to the posterior extremity, while the first-named is intrinsic.[1]

[1] That portion of the Gluteus Maximus described as the second part in *Felis*, was not present in *Procyon*. The caudal or ventral origin of the Biceps Femoris would appear to compensate for its absence. The second part of the Gluteus Maximus of the cat is, in all probability, the same as the high origin of the Biceps Flexor, since it can be traced directly to the intermuscular septum between the Vastus Externus and the Adductor Magnus, and is continued thence to the capsule of the knee-joint.

Gluteus Medius.—The Gluteus Medius arises from the dorsum of the ilium, the under surface of the aponeurosis of the G. Maximus, and, by a separate set of fascicles, from the lateral border and the anterior surface of the sacrum. Fibres pass downward to be inserted into the great trochanter. Posteriorly this muscle is divisible into two planes which anteriorly are fused. The anterior portion is iliac in origin, and is inserted into the trochanter major. Superficially it is supplied by nerves in common with the G. Minimus. Its interior is fibrous. The posterior portion, slightly overlapped by the anterior, arises from the sacrum and is supplied by nerves passing directly from the sciatic at the great sacro-sciatic foramen. It is also supplied on the dorsal surface by a nerve escaping from the great sacro-sciatic foramen in common with the superior gluteal, but distinct from it. This portion of the G. Medius is inserted into the great trochanter as it borders on the digital fossa.

It is evident that a parallel can be here instituted between the G. Maximus and the G. Medius. The sacral part of each muscle can easily be distinguished from the iliac portion. In the case of the G. Medius the division has gone so far as to form the outline of two distinct muscles, but which are not completely separable the one from the other.

Gluteus Minimus.—The Gluteus Minimus arises from the dorsum of the ilium below that surface occupied by the G. Medius. It fuses anteriorly with the G. Maximus. This fusion enables the observer to classify the G. Minimus as a deep lamina of complex muscle, of which the G. Maximus is a superficial lamina, the two planes of cleavage being in this instance so remote from one another posteriorly, as to permit so large a muscle as the G. Medius to be received between them. The same disposition toward planal cleavage witnessed in the G. Medius is also found in the G. Minimus; the superficial lamina, however, is quite rudimentary, and is confined to the anterior fifth of the dorsal surface. Between the two laminæ passes a large trunk from the superior Gluteal set of nerves which supplies both the G. Medius, G. Minimus and ultimately the anterior part of the G. Maximus. The G. Minimus is inserted in the anterior edge of the trochanter major by a narrow glistening tendon, and is in close relation to the hip-joint.

Tensor Vaginæ Femoris.—The Tensor Vaginæ Femoris arises

from the ventral edge of the ilium on a line with and immediately posterior to the Sartorius. It arises by a thin membranous tendon on a level with the great trochanter at the middle of the thigh, and ends in the fascia lata. It does not fuse with the muscles of the Gluteal group.

The structure last named is continuous with the fibres of insertion of the Biceps Femoris at the side of the knee, but is not in a line with the head of the tibia, but rather with the side of the patella. The nerve-supply is probably from the inferior gluteal; the dissection did not permit of an exact identification.

(*b*) *Intrinsic Set.*

The Biceps Femoris.—The Biceps Femoris arises by a broad stout aponeurosis from a spine of the sacrum,[1] and by a musculo-tendinous mass from the tuberosity of the ischium. The muscle forms a broad sheet of fibres over the outer side of the thigh and ends in a second aponeurosis at the lateral margin of the patella, and the head of the tibia. At a point about on a level with the head of the tibia, a slender fascicle is given off that passes over the leg superficially and joins the Soleus, and with the last-named muscle contributes to the formation of the Tendo-Achillis. Beneath the Biceps lies the Tenuissimus. This arises from the under surface of the Gluteus Maximus, and passing down over the sciatic nerve is lost over the fascia of the leg.

The Biceps was found in one dissection to present variation from the above description. The body of the muscle as it arose from the ischium divided into two portions, an anterior and a posterior. The anterior, larger—and at the ischium the more superficial portion—was inserted entirely upon the side of the patella and the external tibial condyle. The posterior portion became superficial about six lines below the tuberosity, and was inserted by a broad, thin surface on the fascia of the leg, and, finally, instead of joining the Soleus, was continuous with the Gastrocnemius at the beginning of the tendo-Achillis. The Tenuissimus instead of arising from the Gluteus Maximus, arose from its tendon of insertion into the third trochanter. It passed to the posterior division of the Biceps, along the hinder border of which it descended to the fascia of the leg.

[1] In Ursus, according to the figure in Cuvier and Lieutaud, this slip is absent.

An examination of the variations of the Biceps Femoris (Biceps Flexor Cruris) results in adapting the above description in its several parts to human anatomy. Sömmering describes the muscle with a second long head from the tuberosity of the ischium; Meckel with a third head from the upper portion of the linea aspera; Wood describes a head arising from the fascia beneath the Gluteus Maximus. This is evidently the same as the Tenuissimus. A slip continuous proximally to the sacrum, has been recorded by Theile and Macalister. A slip may be attached to the external condyle of the tibia. A slip may be inserted in the fascia of the leg, or one may join the tendo-Achillis.

It is further interesting to note that the muscle is variable in *Procyon* as well as in the human subject. In one specimen the Tenuissimus, which may be regarded as homologous with the femoral head of the human muscle, was attached to the femur, while it is commonly seen arising from the Gluteus Maximus. The fact last named would indicate that the muscle is of the same relative value as one of the muscular slips passing between a superficial and a deep muscle of the same group, as instanced in the fascicle occasionally seen passing between the superficial and the deep flexors of the fingers. It is supplied by a separate branch of the sciatic as well as by branches in common with the Biceps. The nerve-supply of the Biceps consists of great numbers of minute branches from the lesser sciatic and its anastomosis with the obturator nerve.

The Semitendinosus.—This muscle arises from the upper end of the tuberosity of the ischium, and by a fleshy slip from the posterior margin of the aponeurosis of the Biceps. The last-named slip joins the main belly at its upper third. The muscle is inserted on the anterior surface of the tibia at its upper third. Its tendon, as is usual, lies directly beneath the tendon of insertion of the Gracilis.

The Semitendinosus, while arising in great measure in common with the Biceps, is inserted on the opposite side of the limb. The nerve-supply is from the sciatic.

The Semimembranosus arises from the entire posterior margin of the innominate bone, excepting a portion a few lines in length near the symphysis, which is occupied by the origin of the Adductor Magnus. It forms in reality two muscles. The first of these —ischio-tibial—arises as a flat band of tendinous fibres from the

tuberosity of the ischium and is inserted into the tibia at the inner tuberosity. The second—the ischio-pubio-femoral—arises from the remaining portion of the posterior margin and is inserted into the femur above the external condyle. Uniting the two is a long fusiform slip, which arises from the ischium above and is inserted with the other division into the femur.

The nerves of the Semimembranosus are numerous and large. The ischio-tibial is supplied by a distinct trunk from the great sciatic nerve. The ischio-pubio-femoral by both this nerve and the obturator. A long branch of the nerve first named runs along the femoral division to its distal third, where it anastomoses with a branch of the anterior crural nerve.

Sartorius.—The Sartorius muscle arises from the anterior superior spinous process of the ilium, by a rough angulated border equalling in length one-third of the anterior border of the ilium, and from a fibrous membrane continuous with the External Oblique muscle of the abdomen. The muscle is broad and ribbon-shaped and is inserted into the capsule of the knee-joint toward its median surface, including the median border of the patella, and passing thence downward to the tibia, where it is inserted membranously on the anterior surface, for nearly one-half the length of the shaft. On the same plane, it is in intimate union with the insertion of the Gracilis. Beneath this plane lies the insertion of the Semitendinosus. The Sartorius is supplied at its upper third by the anterior crural nerve, and at its lower fifth by a deeper-seated branch from the same nerve.

Gracilis.—The Gracilis arises tendinously from the entire length of the symphysis, and muscularly by a thickened border from the descending ramus of the pubis. It is inserted at the median side of the patella, the median tuberosity of the tibia and the corresponding border of the tibia at its proximal third. It is freely supplied both at the proximal and the distal portions by branches of the anterior crural nerve.

Adductor Magnus arises from the lower half of the symphyseal line, the pubis at the beginning of the descending ramus and the under surface of the Gracilis. It is inserted by fleshy fibres into the entire posterior surface of the distal half of the femur. The fibres of insertion form three distinct fasciculi, one, representing the median cord that in the human subject, passes to the minute tubercle above the epiphysis, but which is here fleshy and dis-

tributed over the posterior surface. The remaining portions lie nearer the lateral margin, one of them directly upon it. The nerves are derived from the anterior crural and the obturator.

Adductor Longus arises from the symphysis and the pubic half of the ilio-pectineal line. It is inserted into the femur by an oblique line near the median border. It is supplied by nerves from the anterior crural.

The Pectineus and the Adductor Brevis arise from the ilio-pectineal line, but not from the bone between this line and the acetabulum. They are both inserted tendinously on the A. Longus, but nearer the lateral border. Their nerves are derived from the anterior crural.

Quadriceps Extensor.—The Rectus arises over the acetabulum by a single head. At its proximal seventh the muscle is tendinous and overlaid by the Psoas. It is free throughout, except at the lower fourth of the outer side, where it is joined by the Vastus Externus. It is protected by a sheath derived for the most part from the Vastus Internus. On this sheath is inserted the Tensor Vaginæ Femoris.

The Vastus Internus and Vastus Externus form a continuous mass at the lower third of the thigh, behind the Rectus. They are free from the femur at its upper half; the V. Internus arises for the most part from the front of the shaft of the femur at the base of the trochanter minor, and by a continuous small fleshy line from the entire length of the front of the bone. It is continuous with the Crureus. The V. Externus, V. Internus and Crureus form a muscular bed which is fibrous at its lower half. The nerve-supply of the Quadriceps Extensor is derived from the anterior crural nerve. In addition the Vastus Externus receives four or five branches from the lesser sciatic nerve.

Quadratus Femoris.—The Quadratus Femoris is a stout muscle arising from the tuberosity and the ramus of the ischium, and inserted into the posterior surface of the femur by a rugose crescentic line. It is supplied by a distinct nerve from the great sciatic, which in proportion to the size of the muscle is unusually large.

Obturator Externus.—The Obturator Externus arises from the border of the obturator foramen externally, the descending ramus of the pubis and the ramus of the ischium, and passes forward to be inserted by a tendon which is superficial at its distal half

into the anterior half of the digital fossa. In the anterior part of the muscle is seen an imperfect attempt at the formation of two laminæ. The tendon is here concealed to a greater degree than elsewhere. The muscle receives its nerve-supply from the obturator nerve.

Obturator Internus.—The Obturator Internus arises from the entire inner surface of the innominate bone for a distance equalling the extent of the symphysis pubis. Save at its extreme anterior margin and the trochlear surface as it winds round the border of the ischium, the muscle is fleshy throughout. Both Gemelli muscles are well developed and are fused in front of the main tendon. The muscle is intimately connected with the capsule of the hip-joint and is fused at the insertion with the tendon of the Obturator Externus. The Obturator Internus receives nerves within the pelvis from the internal pudic, and the Gemelli from a separate trunk destined for the Quadratus Femoris.

The Gemelli form a deep lamina of cleavage from the main mass of the Internal Obturator which represents a superficial layer of the same muscle.

Gastrocnemius.—This muscle arises from the femur by two heads. The outer head bears a sesamoid bone.—The fibrous tissue between the femur and this bone are exceedingly stout and coarsely fasciculated. A thin fascia-like membrane extends from the lateral surface of the capsule of the knee-joint to the superficies of the sesamoid. This is continuous with the Vastus Externus muscle, so that when traction is made upon the muscle last named the sesamoid can be moved slightly upward. This muscle, therefore, can aid in fixing the bone at times when the Gastrocnemius and the Plantaris contract. The bone is also supported by bands extending to it from the posterior surface of the capsule.—The outer head of the Gastrocnemius is pierced by a branch of the sciatic nerve to supply the Soleus on its superior surface. Fusing with the under surface of the outer head is the origin of the Plantaris muscle. The inner head is of muscular origin and ribbon-shaped, and is attached directly to the femur without the intervention of a sesamoid bone. The two heads of the muscle fuse at the upper third of the leg, forming a flat, triangular surface which gradually becomes tendinous toward the apex of the triangle to form the tendo-Achillis.[1] An unusually large bursa

[1] There is no slip of origin from the fascia over the head of the fibula as in *Felis*.

intervenes between the concave tuber calcis and the tendon. Under the head of the Biceps muscle it has already been mentioned that the Gastrocnemius may be reinforced by the lower part of this muscle.—The Soleus arises from the head of the fibula only, by a musculo-tendinous origin. It is fusiform, much thicker, and in every way more robust than the Gastrocnemius, and joins the tendo-Achillis six lines above the tuber calcis. The Soleus is fleshy throughout and does not receive any slip of the Biceps Flexor.—The nerve supply of the Gastrocnemius is from the sciatic. The Soleus also is supplied by a branch of the sciatic, passing between the Plantaris and the external head.

Plantaris.—Fusing as it does with the outer head of the Gastrocnemius, the Plantaris can be traced with scarcely any artificial dissection to the Sesamoid bone in the outer head of the Gastrocnemius. The surface of contact between the Plantaris and the Gastrocnemius is fibrous throughout. This is seen to be different from the arrangement in *Felis*, in which animal the Plantaris arises in part from the fascia of the leg. The Plantaris tendon becomes superficial to the outer side of the tendo-Achillis, passes over the calcaneum as a broad aponeurosis, from the distal end of which, on the plantar surface of the foot, the Flexor Brevis Digitorum arises. The motion between the Plantaris and the Flexor Brevis Digitorum is pronounced medianly but absent laterally. The Plantaris may thus be said to be inserted into the calcaneum on its lateral surface, and the Flexor Brevis Digitorum to arise from the same surface. On the median aspect, however, the two muscles are continuous with one another through intermediate fibrous tissue. It is supplied by the sciatic nerve.

Popliteus arises from a shallow pit on the lateral surface of the external condyle by a ligament-like tendon, that passes in a groove horizontally backward to the tibia. The muscular fibres are arranged in a thin sheet and are inserted into the tibia for its upper third. The proximal edge of the muscle is horizontal and in the same line with the tendon of origin. The distal edge is oblique and slightly overlaps the fascia covering the Flexor Longus Pollicis. The nerve supply is from the sciatic.

Flexor Longus Digitorum arises from the proximal half of the posterior surface of the tibia, and from the stout fascia lying on the posterior aspect of the muscle. The very stout, broad tendon formed at the middle of the leg, lies in a groove behind the inter-

nal malleolus in company with the small Tibialis Posticus, and is inserted on the median side of the conjoined tendon at the tarso-metatarsal line. It receives all the fibres of the Musculus Accessorius.

Musculus Accessorius arises from the lateral aspect of the calcaneum, and is inserted on the median half of the conjoined tendon.

Flexor Longus Pollicis arises from the proximal two-thirds of the posterior surface of the shaft of the fibula, and by nearly as long a surface from the tibia. The fibres of the tendon can be traced nearly to the head of the fibula but become free only at the level of the ankle. The tendon lies in the deep recess between the tibia and the fibula, in the pronounced groove on the posterior border of the astragalus, as well as in the depression beneath the *sustentaculum tali* to unite with the conjoined tendon at its lateral half. The conjoined tendon splits into five phalangeal slips, one for each of the five toes—each tendon being inserted into the plantar tubercle of the terminal phalanx.

Lumbricales.—These are three in number and are supplied to the second, third and fourth toes. The muscle for the first toe arises from the tendon of the long flexor of the second, that for the second from the tendon of the third toe, and that for the third from the tendon of the fourth toe. These slips are inserted on the sheath of the flexor tendons, which cannot be separated from the tendon of insertion of the Extensor Longus Digitorum.

Tibialis Posticus arises from the proximal ends of both the tibia and the fibula. It passes downward parallel to and in part concealed by the Flexor Longus Digitorum, in company with the tendon of which it enters a sheath behind the internal malleolus. It is inserted into the scaphoid bone. The posterior tibial group of muscles receives its nerves from the internal popliteal nerve as it passes between the two heads of the Gastrocnemius.

Peroneus Longus arises tendinously from the lateral surface of the head of the fibula, by a head that is slightly narrower than the belly. It becomes tendinous at the middle third of the leg, thence passes through a separate sheath over the external malleolus, it lies in a groove on the calcaneum beneath the *sustentaculum tali* and is inserted into the base of the fifth metatarsal bone.

Peroneus Brevis arises broad and fleshy from the posterior

surface of the fibula at its middle third. Its muscular fibres pass down as far as the external malleolus with the tendon, which is twice as broad as that of the Peroneus Longus and is inserted into the base of the dorsal surface of the fifth metatarsal bone. A slip from the tendon just before the insertion is continuous with the dorsal aponeurosis lying beneath the Flexor Brevis Digitorum. Traction on this sheet slightly extends the toes, a function best seen along the lateral border of the foot.—The nerve-supply is by a branch of the anterior tibial which extends nearly the entire length of this muscle.

Peroneus Tertius arises at the proximal third of the fibula by oblique, delicate, fleshy fibres. The tendon lies in the same groove on the posterior aspect of the external malleolus with that of the Peroneus Brevis. It is inserted with the Extensor Brevis Digitorum at the base of the fifth metatarsal bone.

Tibialis Anticus arises from the outer tibial tuberosity and the tibial tubercle from the anterior tibial crest at its upper third, and from the fascia of the leg. The muscle becomes tendinous at the lower fourth of the shaft of the tibia, and is inserted into the base of the first metatarsal bone. In some subjects a slip arises separately from the interosseous membrane. The muscle receives its nerve-supply from the anterior tibial.

Extensor Longus Digitorum arises by a small narrow tendon from a pit on the external condyle of the femur above that for the Popliteus. The tendon passes downward parallel with the external lateral ligament, and beneath the fascial insertion of the Biceps Flexor Cruris, thence lying in a smooth groove between the head of the fibula and the outer tibial tuberosity it is continuous with the narrow thong of muscular fibre constituting the body of the muscle. The tendons of insertion are formed at the lower third of the tibia, and form a close bundle of rounded cords, that descend to the ankle, at which point they pass through a special loop of the annular ligament to be displayed in a tendon-centre as flat, mutually-supporting bands on the medio-dorsal aspect of the foot. From the distal border of this centre, flat tendons pass to the second and to the fifth toes. The muscle receives its nerves from the anterior tibial at the proximal end.

Extensor Brevis Digitorum arises from the outer surface of the calcaneum and the loop of annular ligament for the last-named muscle. A broad, tendinous expanse, aponeurotic in structure,

furnishes the short, broad tendons of insertion (lying beneath those of the long flexor) into the toes from the second to the fourth. It is joined by the Peroneus Tertius.

Extensor Longus Pollicis.—This was found in one subject only. It arises from the fibula at its upper third.

The intrinsic muscles of the pes embrace the following:—

Flexor Brevis Digitorum.—This flat, muscular sheet arises from the intersection between it and the Plantaris, as this structure underlies the calcaneum. (See the account of the Plantaris.) At the proximal half the muscle is uniformly fleshy. It splits into four slender fascicles. In some specimens the fascicle to the second toe is given off a little higher than the others at the distal half.

Opposite to the metatarso-phalangeal joints, from the second to the fifth, each of the four delicate tendons enters the sheath in common with the corresponding tendons of the Flexor Longus Digitorum and by splitting embraces the last-named tendons.

The ends of each split tendon are inserted on the second phalanx. Passing between the tendons of the short and the long flexors are three muscular slips. They arise from the plantar surface of the conjoined tendon. They are inserted respectively into the tendon of the first, second, and third toes.[1]

The Flexor Brevis Pollicis is represented by two distinct muscles each ending in a sesamoid. The Adductor Pollicis is inserted half way up the lateral border of the second phalanx. According to the terminology of human anatomy, the following would be the arrangement of the Dorsal and Plantar Interossei muscles:—

The first and second Dorsal Interossei are united at the middle by two stout fasciculi. The third Dorsal Interosseous unites with the first Palmar at the distal half of the third metatarsal bone. The fourth Dorsal Interosseous is similarly fused with the second Palmar Interosseous. The third Palmar Interosseous is absent. A small oblique muscle having relations to the second toe similar to those entertained by the Adductor Pollicis to the first, is inserted upon the first phalanx of the second toe.

[1] The arrangement of fibres passing from the short to the long flexor of the toes has received special attention from E. Schulze, (Zeitschr. für wissen. Zool., xvii, 1867, 1) who has figured them as they exist in the dog.

Studying these muscles without reference to human anatomy, the arrangement is simple, and the terminology herewith employed much preferable, in my judgment, to that in the foregoing section.

Five Metatarso-Phalangeal Flexors are present in the foot of the *Procyon*. The least differentiated of these is seen in the third muscle of the series. This muscle remains unspecialized as far as the proximal third of the third metatarsal bone. It then divides into two stout fasciculi, each of which goes to the sesamoid bone of its own side. *Procyon*, as *Felis*, possesses a pair of sesamoid bones to each metatarso-phalangeal joint.—The fourth Metatarso-Phalangeal Flexor is essentially the same in plan as is the third.—That of the second toe, however, exhibits almost complete longitudinal cleavage, two short oblique bands alone uniting the now almost distinct muscles. The lateral half of the muscle arises from the sheath of the Peroneus Longus muscle, the median half arising from the under surface of the first cuneiform in common with the lateral half of the first Metatarso-Phalangeal Flexor. The muscle last named is highly specialized, the two halves being distinct throughout, but for a small oblique fascicle at the proximal end of the two muscles, the median arising as above indicated and the lateral from a supernumerary ossicle lying on the plantar aspect of the third cuneiform bone.—The fifth Metatarso-Phalangeal Flexor is, like the first, highly specialized and composed of two non-communicating slips, both of which arise from a supernumerary ossicle in the sheath of the Peroneus Longus.

The median portion of the same sheath sends distally three radiated fasciculi. The median is homologous with the Adductor Pollicis, the remaining two are functionally adductors to the second and fifth toes respectively.

Opponens Pollicis.—Under this heading is appropriately included a stout muscular fasciculus passing from the under surface of the astragalus and inserted into the base of the first metatarsal bone.

According to the classification of the intrinsic muscles of the foot, proposed by D. L. Cunningham (Journ. Anat. and Physiol., xiii, 1879, 1), by which palmar adductors, dorsal adductors and intermediate flexors are identified, the muscles in *Procyon* exhibit well-developed palmar adductors and intermediate flexors, while the dorsal adductors are rudimentary or absent.

Concluding Remarks.—The tendency for certain muscles, as the Gluteus Medius, the Semimembranosus, the Biceps Cubiti, the Triceps, and the Masseter to undergo partial planal cleavage, *i. e.*, to form distinct laminæ at one part, while but a single lamina, embracing the entire thickness of the muscle, at another, indicates that such muscles are imperfectly differentiated, but are yet sufficiently differentiated to receive nerve-supply from separate sources.

In the process by which a muscle-sheet is changed into a muscle-thong or "cord" (premising such a process ever to take place), the sheet is folded once upon itself. The two halves of the sheet constitute the laminæ. The space between becomes the interlaminate space, and receives the nerves. This retention of a muscle-thong with the laminæ and interlaminate space as seen in many muscles of *Procyon* would indicate a lower type of muscle than any seen in *Felis*, in which genus the tendency exists for the interlaminate space to become obliterated by the fusion of the laminæ. The nerve, however, always enters the muscle at the position of the lines of fusion.

While the changes witnessed in a sheet of muscle undergoing longitudinal *cleavage* are included under the head of progressive development (as is witnessed in the evolution of special slips from the Panniculus Carnosus in the formation of the muscles of the auricle and of the face; and while similar changes are known to occur by which the great vertebro-costal masses send off partially distinct fascicles to various portions of the trunk), those witnessed in the limbs by which distinct laminæ in an early form undergo *fusion*, and thereby become complex in a later form, are to be included under the same general head. In that variety of development by which a single muscle is converted into many muscles by a process of splitting, the portions thereby formed can reunite by a process of splicing. The splitting is carried as far in *Felis* as in *Procyon*, but the splicing process is carried farther in *Felis*.

The number of nerves was found to be subject to considerable variation. Muscles of low degree of specialization such as the Latissimus Dorsi, Biceps Flexor and Semimembranosus were found richer in nerves than highly specialized muscles such as the Tibialis Anticus and the Supinator Longus. Between *Felis* and *Procyon* marked contrasts were presented between muscles of the same name—the lowly specialized muscles in all instances

receiving more nerves in *Procyon* than in *Felis*. The number of nerves diminish as a laminated muscle in *Procyon* becomes highly fused in *Felis*. This was well exhibited in the instance of the Biceps Cubiti.

Under the head of muscle-variations it has been seen that many muscles in *Procyon* correspond to abnormal muscles in man. Some of these have been noted in the text. It is equally instructive to note many that are identical with the human muscles, such, for example, as the rotators of the femur. Other muscles in *Procyon* appear to be beyond the limits of variation of human myology. Among the latter group may be named the continuity of the Plantaris and the Flexor Brevis Digitorum, the accession from the Panniculus to the Pectoralis, and the fusion between the Flexor Longus Pollicis Pedis and the Flexor Longus Digitorum Pedis.

May 23.

The President, Dr. Leidy, in the chair.

Forty-four persons present.

On Bacillus anthracis.—Prof. Leidy stated that Dr. Robert Gladfelter, veterinary surgeon, had submitted to his examination a bottle of blood from a cow. The animal, apparently well on Wednesday, May 10th, and milked the same evening, died the next morning. The cause was not clear but was suspected to be the result of anthrax, charbon, or splenic fever. During the past year a number of cows in the same herd, had died in a similar manner, in Salem Co., N. J. A post-mortem examination was made the following day; and the abdominal viscera were found much conjested; especially the spleen, which was gorged with blood. The specimen of blood, obtained from the spleen was examined the next day, Friday. It teemed with Bacteria, the peculiar form, *Bacillus anthracis*, which is now viewed by most competent authorities as the cause of the frightful affection known as anthrax or splenic fever. The Bacilli were actually more numerous than the blood corpuscles, which appeared unchanged. The Bacilli were completely motionless; straight, bent or zigzag filaments, in the latter condition in pairs or more segments. They measured from 0.006 to 0.042 mm. in length; usually from 0.012 to 0.03 mm. Kept for some days in the blood the filaments underwent division into little chains in two, three, or more dumb-bells, which measure about 0.005 mm., or into isolated micrococci-like particles about 0.0015 mm. Many however of the filaments did not resolve themselves into these minute particles, but appeared only to grow in length and divide into segments of about 0.012 mm. in length.

On Enchytræus, Distichopus and their parasites.—Prof. Leidy remarked that occasionally in lifting a flower-pot or in stirring the earth within, attention is sometimes attracted by the sudden wriggling of a little white worm disturbed from its rest. In the Archiv für Anatomie, 1837, Henle has given an elaborate description of the worm and named it *Enchytræus* in reference to its familliar habitation. The little pot worm is common in our vicinity, especially in damp forests under decaying leaves and timber. It was first noticed in 1773 from Denmark by O. F. Müller, and in 1880 from Greenland by Fabricius. It has also been observed in France and Germany; and therefore the little worm appears to extend over the northern parts of Europe and America.

The same worm I have found in the meadows of Atlantic City, New Jersey, in the usual haunts of *Melampus bidentatus* and *Orchestia agilis*. In mature specimens, about three-fourths of an inch in length, the girdle is well produced, and the body has ten setigerous segments in advance of it and about forty-five behind it. The short pointed setapeds in four longitudinal rows, are in fascicles of three or four to each, in advance of the girdle and two or three to each behind it.

In the Enchytræus of our forests I have repeatedly observed an infusorial parasite, occupying the body cavity, sometimes in considerable numbers, mingled with the normal discoid corpuscles. I propose to name it *Anoplophrya modesta*. In the Enchytræus of the meadows of Atlantic City I observed a different infusorian, occupying the same cavity, remarkable for its great proportionate length. This I propose to name *Anoplophrya funiculus*.

Wishing to ascertain whether the latter did not likewise infest the Enchytræus of our neighboring forests I recently collected a number of little worms at Media, Del., Co., These I obtained from beneath a stone lying in my path to Swarthmore College. They appeared to be robust specimens of *Enchytræus vermicularis*, for which I took them to be. Investigation at home proved them to be different and generically distinct from previous known forms. The worms possess but two rows of setapeds, instead of four as in most others of the family. Hoffmeister and Gruby described the genus *Phreoryctes* as having only two rows of setapeds, but Leydig has shown this to be an error. In view of the error I carefully repeated my examination of the little worms from Media, and am convinced that they possess two rows of setapeds, while in *Enchytræus* I always found four. So much do the former otherwise resemble the latter that it would appear as if they formed a genus directly evolved from *Enchytræus* merely by the suppression of a pair of the four rows of setapeds.

The new genus presents the following characters and may be indicated by the accompanying name.

Distichopus. Form and color as in *Enchytræus*: with a well produced girdle. Setapeds in a single row on each side ventrally, in divergent fascicles of four in advance of the girdle and of three behind it.

Distichopus silvestris. Body cylindrical, white, translucent, with a well produced girdle of whiter color. Upper lip short conical blunt; anal segment thicker than the penultimate, brownish and punctate; anus quinquiradiate. Ten setigerous segments in advance of the girdle, with fascicles of usually three or four setapeds; fifty-five setigerous segments behind the girdle, with usually two or three setapeds. Oral and anal segments without setapeds. Setapeds shorter and stouter than in *Enchytræus vermicularis*, curved at the root, swollen at the middle, and straight towards the point. Length from nine to fifteen lines.

I observed no infusorian in *Distichopus*, but in most of those examined there were found within the intestine minute Gregarines

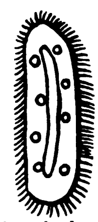
allied to the *Monocystis* of the earth worms, *Lumbricus.* This parasite was perfectly quiescent and was especially remarkable from its frequently containing a variable number of curved elliptical bodies, which I suspect to be spores. Viewing it as a species of *Monocystis* it may thus be briefly characterized.

MONOCYSTIS MITIS. *Gregarina Enchytræi?* Kölliker. Body fusiform, tapering posteriorly and usually acute, anteriorly obtuse or produced into a short mammilla; contents of the usual granular protoplasm as in gregarines, with a central spherical nucleus and nucleolus. Size ranging from .03 mm. to .12 mm. in length. In the smallest individuals the nucleus was indistinct and in some appeared to be absent. The larger ones mostly contained what I supposed to be spores. These are curved elliptical bodies .015 mm. long by .0045 mm. wide, and were collected in a group of usually two or three to seven or eight, sometimes in advance of the nucleus, and sometimes behind it.

Monocystis mitis, 333 diam.

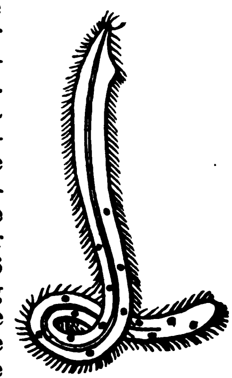
The two Anoplophrya above indicated have the following characters.

ANOPLOPHRYA MODESTA. *Leucophrys.* Jour. Ac. Nat. Sc. 1850, 49, pl. 2, fig. 17. Elongated elliptical, anteriorly rounded, posteriorly somewhat truncated, usually from three to five times the length of the breath; nucleus axial, cylindrical, straight, extending about two-thirds the length of the body; contractile vesicles variable in number and usually in two longitudinal rows. Length from .048 to .12 mm.; breadth .018 to .024 mm. In state of transverse division, the pairs range from .054 to .15 mm. in length. Common and numerous in the body cavity of *Enchytræus vermicularis.*



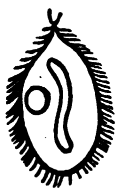
Anoplophrya modesta, 350 diam.

ANOPLOPHRYA FUNICULUS. Long, narrow and ulna-like in shape, from twenty to thirty times the length of the breadth; anterior extremity slightly wider and very obliquely truncated and slightly depressed; posterior extremity bluntly rounded. Nucleus axial, bristle-like, appearing as a double continued line reaching from the posterior end of the body and tapering to a single line in the posterior part of the same. Contractile vesicles minute, in two rows, variable in size and usually occupying the posterior part of the body. Length 0.42 mm. to 0.6 mm. by 0.018 to 0.024 mm. wide. Young individuals 0.15 mm. long by 0.024 wide, were tapering in front and obtuse while they were wider and rounded behind. Inhabiting the body cavity of *Enchytræus vermicularis* from the meadows of the Atlantic coast of New Jersey.



A. funiculus, 175 diam.

In an earth worm, *Lumbricus*, species undetermined and occurring under logs, in the forests in the vicinity of Philadelphia, I detected another species of the above which may be distinguished as follows.



A. melo, 250 diam.

ANOPLOPHYRA MELO. Oval or ovoid, scarcely twice the length of the breadth, with the narrower pole mucronate; nucleus axial, cylindrical, sigmoid, about two-thirds the length of the body; contractile vesicles usually one, or two, or none, large. Length 0.048 mm. to 0.08 mm., breadth 0.032 to 0.04 mm. Pairs in state of transverse division 0.08 by 0.036 mm. to 0.084 by 0.04 mm. Inhabiting the body cavity of *Lumbricus*?

The Rev. Henry C. McCook, D.D., was elected Vice-President and Jacob Binder was elected Curator to fill vacancies caused by the death of Wm. S. Vaux.

Thomas A. Robinson was elected a member of the Council, to fill the vacancy caused by the election of the Rev. Dr. McCook to the Vice-Presidency.

MAY 30.

The President, Dr. LEIDY, in the chair.

Twenty-eight persons present.

The Yellow Ant with its flocks of Aphis and Coccus.—Prof. LEIDY stated that since he had made a communication, published in the Proceedings of April 10th, 1877, on the habits of the Yellow Ant, from time to time, in seeking for other animals, he had incidentally learned that the species is not only a common one of our vicinity, but also that it was habitual with the ant to care for the same two species of *Aphis* and *Coccus* originally noticed in company with it. The ant workers, of the species *Lasius interjectus*, are of a uniform bright amber color, shining and hairy, and measure about $3\frac{1}{2}$ millemetres long.[1] The Aphis is white or pale yellowish and covered with a white waxy secretion, has brownish legs and proboscis, no honey tubes, and is about $2\frac{1}{2}$ mm. long and 2 mm. wide. The Coccus is red with some whitish waxy secretion and is from three-fourths to one millemetre and one-half in length.

On the third of May, near Swarthmore College, Del. Co., a nest of the yellow ants was observed beneath a flat stone, about one

[1]In the original communication the ant was named *Formica flava*, but the Rev. Dr. McCook has determined it to be as here stated.

foot by seven inches broad. Collected on the under side of the stone there were six distinct and closely crowded groups of the white aphis and five of the red coccus. The largest aphis group was three inches by one inch; the smallest one-half inch in diameter. The largest coccus group was an inch and one-half by three-fourths of an inch, and the smallest one-half an inch by one-fourth of an inch. The ground beneath the stone was furrowed by tortuous paths communicating with holes, through which ants were running; but most of these together with their flocks were adherent to the under side of the stone, and occupied a space of about six inches by four inches.

Colorless Garnet and Tourmaline.—Prof. LEIDY further exhibited several brilliant cut specimens of garnet, from Hull, Quebec, Canada. They are transparent, with a pale yellowish tint like an off-colored diamond, and are flawless. Another specimen was a handsome colorless brilliant of achroite or tourmaline from St. Lawrence Co., New York.

JUNE 6.

The President, Dr. LEIDY, in the chair.

Thirty-three persons present.

A paper entitled "On the relative Ages and Classification of the Post-Eocene Tertiary Deposits of the Atlantic Slope," by Angelo Heilprin, was presented for publication.

The deaths of Wm. B. Rogers, a Correspondent, and Samuel P. Carpenter and Andrew C. Craig, members, were announced.

JUNE 13.

Mr. MEEHAN, Vice-President, in the chair.

Twenty-nine persons present.

The following was ordered to be printed:—

ON THE RELATIVE AGES AND CLASSIFICATION OF THE POST-EOCENE TERTIARY DEPOSITS OF THE ATLANTIC SLOPE.

BY ANGELO HEILPRIN.

It may appear surprising that for a period of nearly fifty years after the study of the American tertiary formations was first systematically attempted, there should still have existed among geologists widely varying views, not only relative to the positions occupied by a considerable proportion of the deposits in question in the geological scale, but also relative to the positions occupied by these deposits in respect of each other. Yet such has been the case, and it may still be said to be the case at the present time. The existence of post-eocene deposits along the Atlantic border of the United States has long since been recognized, and their contained fossil remains investigated and delineated by paleontologists of more or less ability. While the opinions expressed by certain geologists as to the age of at least some of these deposits may be said to have been substantially correct, yet in face of the conflicting views of other geologists of no less experience and prominence, which were set forth and maintained with a decisiveness unwarranted by the character of the research upon which they were based, it may be stated that the general outcome of our knowledge respecting the stratigraphy of the deposits here referred to is simply, that they hold a position somewhere intermediate between the eocene and the post-pliocene series.

The post-eocene tertiary deposits have their greatest development, and have been most carefully investigated in the States of Maryland, Virginia, North and South Carolina. In the frequently expressed opinion of Mr. Conrad they represented over the entire area here indicated one geological formation, which that geologist generally asserted to be the miocene, but which, at the same time, he not unfrequently considered to be the equivalent of the British crag, a formation now universally regarded as being of pliocene age.

No attempt appears to have been made to determine whether the deposits were referable to one or several faunal horizons, and the organic remains obtained from them were simply classified as belonging to the miocene or "medial tertiary" period. The circumstance that in North Carolina the proportion of recent to

extinct forms among the imbedded remains was greater than in either Virginia or Maryland did not escape the notice of the observer mentioned, but yet he did not hesitate to conclude (Kerr, Geological Survey of North Carolina, Appendix, p. 25, 1875) that his miocene strata represented "one contemporaneous sea bottom, holding living individuals of certain species throughout its entire length, and which is characterized by some of its species closely resembling existing ones, but many more having no affinity with American shells." How many of the fossil species were by Mr. Conrad considered to be identical with recent forms, it is impossible to determine with any amount of exactitude, since the opinions of that geologist bearing upon this point appear not to have been fixed and to have fluctuated extensively within very brief intervals of time. Thus, while in 1838 (Fossils of the Medial Tertiary Formations, Introduction, p. xvi), it is asserted that of about 200 described species 19 (or less than 10 per cent.) are still among the living fauna, in 1843 (Proc. Phil. Acad. Nat. Sciences, i, p. 328), the number of recent forms is said to be 43 out of a total of 328 described; in 1862, on the other hand, referring to the South Carolina deposits, where the percentage of recent forms had been claimed to be greater than in either of the other three states, Mr. Conrad maintains that "it may be that all the species are extinct" (Proc. Acad. Nat. Sciences, xiv, p. 559). It is further stated (*loc. cit.*) that of the entire number, 581, of miocene shells of the Atlantic stope, the number of forms that could be considered as doubtfully identical with recent species was not more than 30 (or about 5 per cent). The faunal relations existing between these so-called "medial tertiary" deposits and the deposits of the British crag and the faluns of the Loire, at that time supposed to be of nearly equivalent age, were likewise pointed out by Lyell (Journ. Geol. Society, i, pp. 413 *et. seq.*), who also did not fail to notice that in North Carolina "the recent species bore a larger proportion than usual to the extinct" (*loc. cit.*, p. 418). But this geologist, with his characteristic acuteness, further remarks: "As, however, it would be very rash to assume that all the miocene deposits of the United States, especially in countries as far apart as Maryland and South Carolina, were of strictly contemporaneous origin, the fossil faunas of each region should be carefully distinguished and considered separately" (p. 418). Of 147 species of mollusca gathered by Mr. Lyell himself, and which

were subsequently studied with the assistance of Mr. Sowerby, twenty-three (or 15½ per cent.) were considered to be identical with recent forms (p. 419). In the later editions of the "Elements of Geology" (1871, 1874) the deposits in question are referred to the pliocene and miocene, but no clearly defined statement is given as to which belonged to the one age, and which to the other.

From a more careful examination of the South Carolina region than had previously been made, Mr. Tuomey arrived at the conclusion (Geology of South Carolina, 1848), that the post-eocene tertiary deposits of that State belonged to the pliocene, and not to the miocene period, and that, consequently, they were not contemporaneous with the deposits (in Virginia) which had now been firmly recognized as typically representing the miocene of the eastern United States. Of about 170 species of mollusca contained by them, somewhat more than 80 (or nearly 50 per cent.), were considered to be still living along the Atlantic and Gulf coasts (*op. cit.*, pp. 206–208). The pliocene age of these deposits was maintained by Professors Tuomey and Holmes in their "Pleiocene Fossils of South Carolina" (1857), where, also, the deposits of North Carolina (miocene of Emmons, North Carolina Geological Survey, 1858), are referred to the same period. Of 203 species of described invertebrate remains (mollusks, echinoderms, and corals), 85 (or 42 per cent.) were considered to have living analogues (*op. cit.*, Introduction, IX.) The determinations of Tuomey and Holmes for both the South and North Carolina deposits are accepted by Dana for the several editions (1863, 1875, 1880) of his "Manual of Geology," where the "Yorktown" period is made to include the post-eocene tertiary beds of Virginia, Maryland, New Jersey, and Martha's Vineyard, and the "Sumter" period, the similar beds of North and South Carolina. In the "Check List of the Invertebrate Fossils of North America," prepared (doubtless from data furnished by Conrad) in 1864 by Mr. Meek, for the Smithsonian Institution (Miscellaneous Collections, VII.), all the non-eocene or oligocene tertiary fossils of the eastern United States are classed as belonging to the miocene period; and finally, Prof. C. H. Hitchcock, in the "Geological Map of the United States" (1881), accepts the miocene determination for the age of the North and South Carolina deposits, as likewise for the Virginia deposits, and those of the peninsula of Maryland. The deposits of the Maryland east-

shore, of Delaware, and the greater portion of those in New Jersey which lie to the east and south of the "upper marl bed," and whose age has not yet been satisfactorily made out, are embraced within the pliocene (newer tertiary).

In order to facilitate the solution of the stratigraphical problem herein involved, the following faunal lists of the several States (Maryland, Virginia, North and South Carolina) have been prepared, and comparisons between them instituted. The utterly desultory and careless manner in which a very considerable portion of the paleontology of the region referred to has been worked up, has rendered their preparation a matter of great difficulty, and, indeed, if absolute accuracy is concerned, a well nigh impossibility. Not only have species been referred to several distinct genera (and families), and catalogued under their respective generic names independently of each other, but in several instances the identical specimen has been figured and redescribed under two or more forms; species, again, originally described from the deposits of one State, have been subsequently credited (and to the exclusion of the first-named locality) to the deposits of another State. Defective illustrations, and in very many cases the absence of illustrations altogether, have still further increased the difficulties, especially where the described specimens themselves are wanting, or where through an unsatisfactory diagnosis their specific (or even generic!) identification is rendered hopeless. Many of the forms here included are therefore taken on faith, and many will doubtless have to be excluded when fresh material is gathered in the field and re-studied. *Per contra*, many forms, seemingly doubtful, have been excluded, which may possibly have to be reinstated on further examination. Where it has been possible (and this has been the case for most of the forms) the original descriptions of the species have been referred to, and the localities of their occurrence there indicated have been those which have been noted; species said to occur in the deposits of several States have been traced back for re-descriptions, or to papers bearing specially on the paleontology of those States, but very little reliance being placed on general enumerations of distribution. By this means it has been hoped to render the lists as complete and free from error as could reasonably be made possible, and while, doubtless, various modifications will eventually have to be introduced, it is

confidently believed by the author that they so far represent the true state of matters as to permit of positive conclusions being drawn from them.

The comparisons here instituted between the molluscan faunas from the deposits of the several States have been made separately for the lamellibranchiata and the gasteropoda; and it may be stated at the outset that the results obtained from the independent examination of these two groups of organisms have been found singularly confirmative of each other. The letters following the name of a species denote that the form is also found in the State or States indicated by their respective characters; but it must be noted in the case of the gasteropoda, that comparisons, as indicated by such initial characters, are made between certain States only, and, therefore, it is not to be concluded from the examination of a single list, that a given form there designated is necessarily wanting in a State whose characters are not indicated in that list. Thus, in the South Carolina list only the North Carolina species are specially indicated, although several of these last, and others, are also found in the Virginia and Maryland deposits; so, again, in the Virginia list, no special reference is made to the Maryland forms.

Tables of the Post-Eocene Tertiary Lamellibranchiata of South Carolina and North Carolina.

South Carolina.

Anomia ephippium,	N. C.
Placunomia plicata,	
Ostrea Virginiana,	N. C.; Va.; M.
" Ravenelliana,	
Chama corticosa,	N. C.; Va.
" arcinella,	N. C.
" congregata,	N. C.; Va.
Plicatula marginata,	N. C.; Va.; M.
Janira hemicycla,	
" affinis,	
Pecten Mortoni,	N. C.
" eboreus,	N. C.; Va.
" comfarilis,	N. C.
" Peedeensis,	N. C.
" septemnarius,	Va.; M.
Mytilus inflatus,	
" inorassatus,	N. C.
Arca hians = A. propatula?	Va.
" incile,	N. C.; Va.; M.
" costata,	N. C.
" centenaria,	N. C.; Va.; M.
" rustica,	
" lienosa,	N. C.
= A. Floridana,	
" scalaris,	N. C.; Va.
" incongrua,	
" pexata,	
" plicatura,	N. C.; Va.; M.
(A. improcera,)	
(A. æquicostata,)	
(A. transversa)	
Pectunculus subovatus,	N. C.; Va.; M.
" lentiformis,	N. C.; Va.; M.

Pectunculus passus, N. C.; Va.
" quinquerugatus, N. C.
" lævis,
" aratus, N. C.
" transversus,
Yoldia limatula, N. C.; Va.; M.
Leda acuta, N. C.; M.
Nucula proxima,
= N. obliqua, N. C.; Va.; M.
Lucina contracta,
= L. filosa, N. C.; Va.; M.
anodonta, N. C.; Va.; M.
Pennsylvanica, N. C.
radians,
= L. Antillarum, N. C.
squamosa,
= L. pecten, N. C.; Va.
cribraria, M.
divaricata, N. C.; Va.; M.
costata,
crenulata, N. C.; Va.; M.
multilineata, N. C.
trisulcata,
Cardium Carolinense,
= C. magnum? N. C.
" muricatum, N. C.
" sublineatum, N. C.; Va.
Cardita arata, N C.; Va.; M.
" granulata, N. C.; Va.; M.
" tridentata, N. C.?
" carinata, N. C.
" perplana, N. C.
" abbreviata, N. C.
Astarte undulata, N. C.; Va.; M.
" bella, N. C.
Gouldia lunulata, N. C.; Va.
Crassatella undulata, N. C.; Va.; M.
" Gibbesii, N. C.
Cyrena densata, N. C.; Va.
Rangia clathrodonta, N. C.; Va.
Venus Rileyi, N. C.; M.
Venus mercenaria, N. C; Va.?; M.?
" athleta, N. C.
" tridacnoides, N. C.; Va.; M.
" fermagna, Va.; M.?
Cytherea subnasuta, M.
" reposta, N. C.; Va.
" Sayana, N. C.; Va.; M.
" cribraria, N. C.
= C. punctulata?
" cancellata,
Circe metastria, N. C.; Va.
Artemis intermedia, N. C.
Petricola pholadiformis,
Tellina biplicata, N. C.; M.
" alternata, N. C.
" lusoria, N. C.; Va.
" polita, N. C.
Strigilla flexuosa, N. C.
Psammocola Pleiocena,
Cumingia tellinoides, Va.
Amphidesma carinata, M.
" equalis, N. C.
" orbiculata,
" æquata, N. C.
Donax variabilis, N. C.?
Standella fragilis, N. C.?
Mactra similis, N. C.
= M. solidissima,
" lateralis, N. C.
" congesta, N. C.; Va.;
Pandora trilineata, N. C.? Va.
Panopæa reflexa, N. C.; Va.; M.
Corbula cuneata, N. C.; M.
" inequale, Va.; M.
Pholadomya abrupta, N.C.; Va.; M.
Solecurtus Caribæus, N. C.
Solen ensis, N. C.; M.
Pholas costata, N. C.; Va.? M.?
" oblongata, N. C.
" Memmingeri, N. C.

NORTH CAROLINA.

Anomia ephippium, S. C.
Ostrea Virginiana, S. C.; Va.; M.
Pecten comparilis, S. C.
Pecten eboreus, S. C.; Va.
" Clintonius, Va.; M.
= P. Magellanicus.

Pecten Peedeensis, S. C.
" Mortoni, S. C.
" Jeffersonius, Va.; M.
" Madisonius, Va.; M.
" vicenarius.
Plicatula marginata, S. C.; Va.; M.
Mytilus incrassatus, S. C.
Crenella, sp.?
Chama arcinella, S. C.
" corticosa, S. C.; Va.
" congregata, S. C.; Va.
" striata.
Arca lienosa, S. C.
= A. Floridana.
" limula, Va.
" scalaris, S. C.; Va.
" incile, S. C.; Va.; M.
" centenaria, S. C.; Va.; M.
" cælata, S. C.
" idonea, Va.; M.
" plicatura, S. C.: M.; Va.
" brevidesma.
" subsinuata.
Pectunculus subovatus,
S. C.; Va.; M.
" lentiformis,
S. C.; Va.; M.
" aratus, S. C.
" tricenarius.
" passus, S. C.; Va.
" Carolinensis.
" quinquerugatus, S. C.
Leda acuta, S. C.; M.
Yoldia limatula, S. C.; Va.; M.
Nucula proxima, S. C.; Va.; M.
= N. obliqua.
Lucina Pennsylvanica, S. C.
" contracta, S. C.; Va.; M.
= L. filosa.
" crenulata, S. C.; Va.; M.
" anodonta, S. C.: Va.; M.
" radians, S. C.
= L. Antillarum.
" divaricata, S. C.; Va.; M.
" multilineata, S. C.
" squamosa, S. C.; Va.
= L. pecten.
Loripes elevata.
Mysia Americana (acclinis).
Cardium Carolinense, S. C.
= C. magnum?
" muricatum, S. C.
" sublineatum, S. C.; Va.
Glycocardia granula.
Isocardia fracterna, Va.; M.
Cardita arata, S. C.; Va.; M.
" perplana, S. C.
" granulata, S. C.; Va.; M.
" abbreviata, S. C.
" tridentata, S. C.
" carinata, S. C.
Pleuromeris decemcostata.
Astarte bella, S. C.
" clathra.
" undulata, S. C.; Va.; M.
" curta.
Gouldia lunulata, S. C.; Va.
Crassatella undulata,
S. C.; Va.; M.
" Gibbsii, S. C.
" Marylandica. M.
" melina, Va.; M.
Verticordia, sp.?
Cyrena densata, S. C.; Va.
Rangia clathrodonta, S. C.; Va.
Venus mercenaria, S. C.; Va.? M.?
" tridænoides, S. C.; Va.; M.
" Rileyi, S. C.; M.
" alveata, Va.; M.
" latilirata, Va.
" athleta, S. C.
Cytherea Sayana, S. C.; Va.; M.
" reposta, S. C.; Va.
" cribraria, S. C.
= C. punctulata?
Circe metastria, S. C.; Va.
Artemis transversus.
= A. intermedia? S. C.
" acetabulum, Va.; M.
Tellina biplicata, S. C.; M.
" lusoria, S. C.; Va.
" alternata, S. C.
" polita, S. C.
" arctata.

Strigilla flexuosa, S. C.
Amphidesma æquata, S. C.
" equalis, S. C.
Mulinia variabilis.
Mactra congesta, S. C.; Va.
" oblongata, S. C.?
= Standella fragilis?
" lateralis, S. C.
" similis, S. C.
= M. solidissima.
Donax, sp.?

Pandora trilineata? S. C.; Va.
Panopæa reflexa, S. C.; Va.; M.
Corbula cuneata, S. C.; M.
Pholadomya abrupta, S. C.; Va.; M.
Solecurtus Caribæus, S. C.
Solen ensis, S. C.; M.
Pholas costata, S. C.; Va.? M.?
" oblongata, S. C.
" Memmingeri, S. C.

An examination of the preceding lists shows that of about 103 forms of lamellibranchiate mollusks found in the South Carolina deposits no less than 74–78 (or about 74 per cent.) are also found in the deposits of North Carolina; these last being represented by an almost equal number (106) of specific forms, the relative percentages of those common to the two States will necessarily be nearly identical. We have thus *prima facie* evidence that the deposits characterized by these remains belong very nearly, if not absolutely, to the same geological horizon. On the other hand, of the South Carolina forms at most only 43 (or 42 per cent.) are indicated as being found in Virginia, and a still smaller number, 34 (or 33 per cent.) in Maryland. We have here, therefore, strong evidence tending to prove that the deposits of the last mentioned States represent a horizon different from those indicated by the deposits of South Carolina. Similarly, of the 106 North Carolina species, at most only 48 (or 46 per cent.) are common to Virginia, and 36 (or 34 per cent.) to Maryland, a result that strikingly confirms the conclusion that has just been drawn.

Passing now to the examination of the Virginia lamellibranchiates, we find, as is shown in the following table, a total of about 109 specific forms:

VIRGINIA.

Anomia Ruffini.
Ostrea sculpturata.
" disparilis.
" Virginiana, S. C.; N. C.; M.
" subfalcata.
Pecten fraternus.
" Rogersi.
" biformis.

Pecten Virginianus.
" tricenarius.
" Jeffersonius, N. C.; M.
" dispalatus.
" septemnarius, S. C.; M.
" Clintonius, N. C.; M.
= P. Magellanicus.
" eboreus, S. C.; N. C.

Pecten Madisonius, N. C.; M.
" decemnarius.
Plicatula marginata, S. C.; N. C.; M.
Perna maxillata, M.
Crenella æquilatera.
Arca centenaria, S. C.; N. C; M.
" incile, S. C.; N. C.; M.
" idonea, N. C.; M.
" protracta, S. C.? N. C.?
= A. lienosa?
" scalaris, S. C.; N. C.
" propatula (hians) S. C.
" limula, N. C.
" plicatura, S. C.; N. C; M.
Pectunculus subovatus, S. C.; N. C.; M.
" tumulus.
" passus, S. C.; N. C.
" lentiformis, S. C.; N. C.; M.
Yoldia limatula, S. C.; N. C.; M.
Nucula obliqua, S. C.; N. C.; M.
(N. proxima).
Lucina squamosa, S. C.; N. C.
= L. pecten.
" crenulata, S. C.; N. C.; M.
" divaricata, S. C.; N. C.; M.
" anodonta, S. C.; N. C.; M.
" contracta, S. C.; N. C.; M.
= L. filosa.
" Leana (lens).
" edentula.
Mysia Americana, N. C.
Kellia lævis.
" striata.
Erycinella ovalis.
Sphærella subvexa.
Chama corticosa, S. C.; N. C.
" congregata, S. C.; N. C.
Cardium Virginianum.
" laqueatum, M.
" sublineatum, S. C.; N. C.
Isocardia fraterna, N. C.; M.
Cardita arata, S. C.; N. C.; M.
" granulata, S. C.; N. C.; M.
Astarte undulata, S. C.; N. C.; M.
Astarte (Euloxa) latisulcata.
" arata.
" Coheni.
" concentrica.
" lineolata.
" symmetrica.
Gouldia lunulata, S. C.; N. C.
Crassatella undulata, S. C.; N. C.; M.
" melina, N. C.; M.
Cyrena densata, S. C.; N. C.
Rangia clathrodonta S. C.; N. C.
Venus capax.
" ascia?
" latilirata. N. C.
" mercenaria? S. C.; M.?
" permagna, S. C.; M.?
" alveata, N. C.; M.
" Rileyi, S. C.; N. C.; M.
" tridacnoides, S. C.; N. C.; M.
Circe metastria, S. C.; N. C.
Cytherea obovata.
" reposta, S. C.; N. C.
" Sayana, S. C.; N. C.; M.
" densata.
" Virginica.
" cortinaria.
Artemis acetabulum, N. C.; M.
Petricola centenaria, M.
Tellina declivis.
" egena.
" lusoria, S. C.; N. C.
Abra subreflexa.
Cumingia tellinoides, S. C.
Mactra modicella.
" delumbis, M.
" congesta, S. C.; N. C.
" triquetra.
Thracia transversa.
Anatina antiqua.
Pandora crassidens, S. C.; N. C.
= P. trilineata.
" aremosa.
= P. trilineata?
Mya producta, M.
" corpulenta.

Poramya subovata.		Saxicava pectorosa.	
Corbula inequale,	S. C.; M.	Pholas (?) rhomboidea.	
Pholadomya abrupta,	S. C.; N. C.; M.	" acuminata,	S. C.? N. C.? M.?
Panopæa reflexa,	S. C.; N. C.; M.	= P. costata?	
Solen magnodentatus?		Teredo fistula.	
Saxicava bilineata, = S. rugosa.	M.	Gastrochæna ligula.	

NOTE.—The following species described by H. C. Lea (Trans. Amer. Philos. Soc. IX, new series), based upon young shells, or upon such as barely admit of characterization, have been omitted from the enumeration: *Avicula multangula, Anatina tellinoides, Cytherea elevata, C. spherica, Leda acutidens, L. carinata, Modiola spinigera, Mya reflexa, Nucula dolabella, N. diaphana, Panopea dubia, Petricola compressa, Pecten micropleura, P. tenuis, Plicatula rudis, Psammobia lucinoides, Teredo calamus.*

Of these 109 species, as has already been stated, at most only 43 (or 40 per cent.) are common to South Carolina, and about 48 (or 44 per cent.) to North Carolina. Compared with the Maryland deposits the proportion of forms common to the two states is found to be not very different from the proportions just indicated, or about 38 per cent. (about 41 species).[1]

From the so-called "medial tertiary" of Maryland there have thus far been described about 98 species of acephalous mollusks:—

MARYLAND.—NEWER GROUP.

Amphidesma carinata,	S. C.	Cardium laqueatum,	Va.
" subovata,		Corbula cuneata,	S. C.; N. C.;
Arca idonea,	N. C.; Va.	" idonea	
" incile,	S. C.; Va.	" inequalis,	S. C.; Va.
" centenaria,	S. C.; Va.	Crassatella Marylandica,	N. C.
" improcera,	S. C.; N. C.; Va.	" undulata,	S. C.; N. C.; Va.
Artemis acetabulum,	N. C.; Va.	Cytherea Sayana,	S. C.; N. C.; Va.
Astarte vicina?		" albaria,	
" cuneiformis,		" Marylandica,	
" perplana,		" staminea,	
" obruta,		Isocardia fraterna,	N. C.; Va.
" undulata,	S. C.; N. C.; Va.	Leda acuta,	S. C.; N. C.
Cardita arata,	S. C.; N. C.; Va.	" concentrica,	
" protracta,		Yoldia lævis,	S. C.; N. C.; Va.
" granulata,	S. C.; N. C.; Va.	= Y. limatula,	

[1] The Maryland deposits, in the comparisons thus far, have for convenience been taken to represent one geological horizon; their division into two groups, and the relations of each of these groups with the deposits of the several other States, are specially considered further on.

Nucula proxima, S. C.; N. C.; Va.
= N. obliqua,
Lepton (?) mactroides,
Lucina anodonta, S. C.; N. C.; Va.
" subobliqua,
" cribraria, S. C.
" contracta, S. C.; N. C.; Va.
= L. filosa,
" divaricata, S. C.; N. C.; Va.
Mactra ponderosa,
" fragosa,
" subcuneata,
" delumbis, Va.
Mya producta, Va.
Ostrea Virginica, S. C.; N. C.; Va.
Panopæa Americana,
" reflexa, S. C.; N. C.; Va.
" porrecta,
Pecten Madisonius, N. C.; Va.
" Jeffersonius, N. C.; Va.
" Clintonius, N. C.; Va.
" septemnarius, S. C.; Va.
Pectunculus subovatus,
S. C.; N. C.; Va.
Petricola centenaria, Va.
Plicatula marginata,
S. C.; N. C.; Va.
Pholadomya abrupta,
S. C.; N. C.; Va.
Pholas ovalis. S. C.? N. C.? Va.?
= P. costata?
Saxicava rugosa, Va.
Solen ensis, S. C.; N. C.
Tellina æquistriata,
" biplicata, S. C.; N. C.
Venus tetrica,
" permagna? S. C.; Va.
" alveata, N. C.; Va.
" inoceriformis,
" tridacnoides, S.C.; N.C.; Va.
" mercenaria? S.C.; N.C.; Va.?
" Rileyi, S. C.; N. C.; Va.
" cuneata.

Maryland.—Older Group.

Arca callipleura,
" subrostrata,
" Marylandica,
" triquetra,
Artemis acetabulum, N. C.; Va.
Astarte exaltata,
" varians,
Cardium craticuloides,
" leptopleura,
Corbula idonea,
" elevata,
Crassatella melina, Va.; N. C.
" turgidula,
Cytherea subnasuta, S. C.
Isocardia Markoei,
Leda liciata,
Lima papyria,
Lucina Foremani,
Lucina subplana,
" crenulata, S. C.; N. C.; Va.
Modiola Ducatellii,
Mytilus incurva,
Pecten Humphreysianus,
" Madisonius, N. C.; Va.
Pectunculus parilis,
" lentiformis,
S. C.; N. C.; Va.
Perna maxillata, Va.
Pholas costata? S. C.; N. C.; Va.
(P. ovalis.)
Panopæa porrecta,
Tellina lenis,
Venus Mortoni?
(V. cuneata?)
" alveata, N. C.; Va.

Note.—Several species formerly credited to this State have been intentionally omitted, there not being sufficient evidence to prove their occurrence there.

Of these 98 about 34 (35 per cent.) are common to South Carolina, 36 to North Carolina (37 per cent.), and 41 to Virginia (42 per cent.). It has, however, been shown in a previous paper (Heilprin, Proc. Acad. Nat. Sciences, 1880, pp. 20, *et. seq.*) that the Maryland deposits actually represent two distinct horizons—respectively designated (temporarily) as the "newer" and "older" groups—and, therefore, in order to have a proper appreciation of the value of these proportions it will be necessary to consider the two divisions in their relations to the several States separately.

The deposits of the "newer" group, as will be seen from the preceding enumeration, contain 66 species, and those of the "older" group, 32 species. Of the former about 33 (50 per cent.), and a nearly equal number, 32 (49 per cent.), are common respectively to South and North Carolina, whereas of the latter, only 4 (13 per cent.) are found in the first named State, and 7 (22 per cent.), in the second.[1] While the "newer" group shows a considerably higher percentage of forms common to both South and North Carolina than the deposits of the State treated as a whole, this percentage is still less than that which might naturally be expected to exist between formations (removed by about equal distances) representing an equivalent age. The rational inference is, therefore, that the deposits in question are not of contemporaneous formation. Compared with the deposits of Virginia the fauna of the "newer" group shows a somewhat more decided relation than to the deposits of the States just mentioned, for we now find the percentage of common forms increased to 56 (37 species). But even with this figure it would be rash to insist upon an equivalency being proved. Nor is the relation of the "older" group to the Virginian formation much more pronounced than it is to the North Carolinian, but no special deductions from agreements or differences of percentages can be made in this instance, since the number of both common and restricted forms is very limited.

The conclusions reached from the examination thus far of the lamellibranchiate fauna are: That the South and North Carolina formations represent one and the same horizon, and one distinct from the horizon or horizons indicated by the Virginia and Maryland formations. It now remains to be determined what

[1] These proportions strikingly corroborate the author's original assumption of two distinct horizons, based upon an examination of Maryland fossils alone.

support this conclusion receives from the study of the fossil faunas in their relation to the faunas of existing seas, and to ascertain through the same means what relation the various horizons bear toward each other.

SPECIES STILL LIVING FOUND FOSSIL IN THE SOUTH CAROLINA DEPOSITS.[1]

Anomia ephippium (A. Conradi).
? Placunomia plicata.
Ostrea Virginiana.
Chama arcinella.
Arca lienosa = A. Floridana.
" incongrua.
? " pexata.
Yoldia limatula (Leda lævis).
Leda acuta.
Nucula proxima = N. obliqua.
Lucina contracta = L. filosa.
" Pennsylvanica.
" radians = L. Antillarum.
" squamosa (L. speciosa) = L. pecten.
" divaricata (L. Conradi).
" crenulata.
? Cardium Carolinense = C. magnum ?
" muricatum.
? Cardita tridentata.
Gouldia lunulata.
Pandora trilineata.
Venus mercenaria.
? Cytherea cribraria = C. punctulata ?
Cytherea cancellata (C. cingenda).
Petricola pholadiformis.
Tellina alternata.
" polita.
" lusoria.
Strigilla flexuosa.
Cumingia tellinoides.
Amphidesma (Abra) equalis.
" (Semele) orbiculata.
? Donax variabilis.
Standella fragilis (Mactra oblongata).

[1] The author desires to express his indebtedness to Mr. George W. Tryon, Jr., through whose kind assistance most of the comparisons with recent forms were made.

Mactra similis. = Hemimactra solidissima.
" lateralis.
Salecurtus Caribæus (Siliquaria Carolinensis).
Solen ensis (S. directus).
Pholas costata (P. arcuata).
" (Dactylina) oblongata (P. producta).

NOTE.—About ten other species have been considered by various authors to be equivalents of recent forms, but since their identification as such has been at best but very doubtful, and in most cases strictly erroneous, they have been omitted. Among these are :

Lucina anodonta, at one time considered by Mr. Conrad to be identical with a species living along the Florida coast. Although very closely resembling the *L. Floridana*, it may, nevertheless, be readily distinguished from it by the greater thickness of its shell, and the greater profundity of the lunules.

Cardita arata.—This species differs, as stated by Conrad (Mioc. Foss., p. 12), from the recent *C. Floridana* of the Florida coast in being proportionately longer and broader behind, and in having the ribs crossed by "crowded subsquamose transverse wrinkles," instead of "thick transverse tubercles."

Cardita granulata.—According to Conrad (Mioc. Foss., p. 13), this shell "so nearly resembles *C. borealis*, a recent species of the eastern coast, that I think it will prove to be the same, when more specimens of the latter shall be obtained for comparison." This identification, which was subsequently rejected by Conrad himself, has for its support the very similar general appearance presented by the two shells in question, but closer examination shows the *C. granulata* to be almost invariably a considerably more elevated (less rotund) form than the *C. borealis*.

Artemis intermedia.—Not readily confoundable with either the *A. concentrica* (Born) or *A. Floridana* (Conr.).

Cytherea Sayana.—More produced (less rounded) than the recent *C. convexa*.

Rangia clathrodonta.—More elongated than the recent *R. cyrenoides*.

Admitting both the positive and somewhat doubtful forms from the above list to be recent, then we have as a proportion to extinct forms 40 to 103, or 39 per cent.; or, if the six doubtful ones are omitted, 34 to 103, or 33 per cent.

The following recent species may be considered to occur in the North Carolina deposits.

Anomia ephippium.
Ostrea Virginiana.
Pecten Clintonius = P. Magellanicus.
Arca lienosa = A. Floridana.
Leda acuta.
Yoldia limatula (Leda lævis).
Nucula proxima = N. obliqua.
Chama arcinella.

? Cardita tridentata.
Gouldia lunulata.
? Cardium Carolinense = C. magnum?
" muricatum.
Lucina Pennsylvanica.
" contracta = L. filosa.
" crenulata.
" radians = L. Antillarum.
" divaricata (L. Conradi).
" squamosa (L. speciosa) = pecten.
Venus mercenaria.
? Cytherea cribraria = C. punctulata?
Tellina lusoria.
" alternata.
" polita.
Strigilla flexuosa.
Mactra oblongata = Standella fragilis.
" lateralis.
Mactra similis = Hemimactra solidissima.
Solen ensis.
Solecurtus Caribæus (Siliquaria Carolinensis).
Pholas costata (P. arcuata).
Pholas (Dactylina) oblongata.
? Pandora trilineata.

Of the above 32, which constitute 30 per cent. of the lamellibranchiate fauna of the State, all, with only one exception—*Pecten Clintonius* (*Magellanicus*)—also occur in the South Carolina deposits. Although the percentage of recent forms in the North Carolina formations is thus shown to be considerably lower than in South Carolina, yet in view of the very strong correspondence—one might, indeed, say identity—existing between the two faunas generally, this variation can scarcely be taken to affect the conclusion already arrived at as to the contemporaneity of the two formations.

In Virginia (of 109 forms) the number of recent species, including several doubtful ons, is reduced to 16, as exhibited in the accompanying enumeration:

Ostrea Virginiana.
Pecten Clintonius = P. Magellanicus.
? Arca protracta = A. lienosa (*et* A. Floridana)?
Yoldia limatula.
Nucula obliqua = N. proxima.
Gouldia lunulata.

Lucina squamosa (L. speciosa) = L. pecten.
" crenulata
" divaricata.
" contracta = L. filosa.
? Venus mercenaria.
Tellina lusoria.
Cumingia tellinoides.
Pandora crassidens = P. trilineata.
Saxicava bilineata = S. rugosa.
? Pholas acuminata = P. costata?

The percentage (15) is here, therefore, brought down considerably lower than in either of the preceding States, a circumstance not only strikingly confirming the assumption of non-contemporaneity (as has already been drawn from comparisons made between the different faunas themselves) in the deposits in question, but equally proving that the Virginia deposits are anterior (older) in date to those of both South and North Carolina.

The number of recent species occuring in the Maryland deposits taken as a whole (*i. e.*, as embracing both the "newer" and "older" groups, and comprising consequently 98 specific forms of acephalous mollusks) is somewhat less than in Virginia, namely (including two or three doubtful forms), 13:

Leda acuta.
Yoldia limatula (Leda lævis).
Nucula proxima = N. obliqua.
Lucina crenulata.
" contracta = L. filosa.
" divaricata.
Ostrea Virginiana.
Pecten Clintonius = P. Magellanicus.
Panopea Americana.[1]

[1] I have here provisionally included the *Panopæa Americana* among the recent forms, although I am somewhat doubtful as to its right to a place there. The shell certainly very greatly resembles that of the recent *P. Aldrovandi* from the Mediterranean, from which, in fact, it appears to differ only in the form of the posterior truncature, which in the recent species carries up the hinge line to a higher level than in the fossil. While the form of the American shell is very constant, that of the European is stated to be very varying, and therefore the distinction pointed out may on a closer examination between specimens be found to have no specific value. By Searles Wood ("Monograph of the Crag Mollusca," ii, p. 283, Palæontogr. Soc. Reports) the *P. Americana* (and *P. reflexa*) is considered identical with the *P. Faujasii* (more properly *P. Menardi*), a common

? Venus mercenaria.
Solen ensis.
Saxicava rugosa (S. bilineata).
? Pholas ovalis = P. costata ?

Of this number 12 are found in the deposits of the "newer" group, and consequently constitute about 18 per cent. of its lamellibranch fauna; on the other hand, at most, only 2 occur in the deposits of the "older" group. We have here, therefore, not only a further corroboration of the existence in the State of two distinct horizons, but what might almost be considered positive proof that the upper Maryland formation ("newer" group), occupies a horizon very nearly identical with that of the (or the great bulk of the) Virginia formation, and one considerably lower than that indicated by the South and North Carolina deposits, despite the circumstance that the general relations existing between the respective faunas in the two cases are not very different.

The following statement summarizes the results obtained from the examination of the lamellibranch fauna:

Of about 103 South Carolina species—
74–78 are found in North Carolina = 74 per cent.
43 are found in Virginia = 42 per cent.
34 are found in Maryland = 33 per cent.
34–40 are recent = 33–39 per cent.

Of about 106 North Carolina species—
74–78 are found in South Carolina = 74 per cent.
48 are found in Virginia = 46 per cent.
36 are found in Maryland = 34 per cent.
32 are recent = 30 per cent.

Of about 109 Virginia species—
43 are found in South Carolina = 40 per cent.
48 are found in North Carolina = 44 per cent.
41 are found in Maryland = 38 per cent.
16 are recent = 15 per cent.

European fossil, and one which had frequently been confounded with the recent *P. Aldrovandi;* but the American species appears to be at least as much related, if not more so, to the living form. The *P. reflexa* is stated by Mayer (*Catalogue Systématique des Foss. des Terr. Tert.*, ii, pp. 25 and 42) to be living on the coast of New Zealand, and to be identical with the *P. Solandri* of Gray; the angulation on the posterior slope of the latter, however, readily distinguishes the two.

Of about 98 Maryland species—

34 are found in South Carolina = 35 per cent.
36 are found in North Carolina = 37 per cent.
41 are found in Virginia = 42 per cent.
13 are recent = 13 per cent.

Of about 66 Maryland "Newer" group species—

33 are found in South Carolina = 50 per cent.
32 are found in North Carolina = 49 per cent.
37 are found in Virginia = 56 per cent.
12 are recent = 18 per cent.

Of about 32 Maryland "Older" group species—

4 are found in South Carolina = 13 per cent.
7 are found in North Carolina = 22 per cent.
8 are found in Virginia = 25 per cent.
2 are recent = 7 per cent.

The examination of the gasteropod faunas of the several States, as will be seen from the summary further on, very strongly confirms the results that have been obtained from the investigation of the acephalous mollusks.

The following enumeration exhibits the species that have been described from the deposits of South and North Carolina.

South Carolina.

Cancellaria reticulata,	N. C.
" depressa.	
" venusta.	
Conus adversarius,	N. C.
" diluvianus,	N. C.
Crucibulum multilineatum,	N. C.
" costatum,	N. C.
" ramosum,	N. C.
" dumosum,	N. C.
Cypræa Carolinensis,	N. C.
Crepidula fornicata,	N. C.
" spinosa,	N. C.
— C. aculeata.	
" plana,	N. C.
— C. unguiformis.	
" costata.	
Columbella avara.	
Dentalium attenuatum,	N. C.
— D. dentale.	
Dentalium Pliocenum.	
" thallus,	N. C.
Dolium galea.	
Ecphora quadricostata,	N. C.
Fasciolaria distans,	N. C.
— F. tulipa.	
" (?) gigantea.	
" Tuomeyi.	
Fulgur carica,	N. C.
" perversus,	N. C.
" canaliculatus,	N. C.
" Conradi (incile).	
" Carolinensis.	
(F. excavatus),	N. C.
" pyrum.	
(F. spiratus),	N. C.
Ficus reticulatus,	N. C.
Fusus exilis,	N. C.
Fissurilla redimicula,	N. C.

Galeodia Hodgei,	N. C.
Hipponyx Bullii.	
Infundibulum centralis,	N. C.
Littorina irrorata.	
Marginella limatula,	N. C.
" oliviformis,	N. C.
Mitra Carolinensis,	N. C.
Monodonta Kiawahensis.	
Murex umbrifer,	N. C.
Natica heros,	N. C.
" duplicata,	N. C.
" canrena,	N. C.
" Caroliniana.	
Nassa vibex,	N. C.
" trivittata,	N. C.
" obsoleta,	N. C.
" (?) lunata.	
Obeliscus arenosa,	N. C.
Oliva literata,	N. C.
Pleurotoma lunata,	N. C.
Ptychosalpinx porcinum,	N. C.
" multirugatum,	N. C.
Purpura tridentata.	
Petaloconchus sculpturatus,	N. C.
Ranella caudata,	N. C.
Scalaria multistriata,	N. C.
" clathra,	N. C.
= S. angulata.	
Solarium perspectivum.	
Terebra Carolinensis,	N. C.
" unilineata,	N. C.
Trivia pediculus,	N. C.
Turritella striata.	
" exaltata.	
" Burdenii,	N. C.
" Etiwaensis,	N. C.
Trochus philantropus,	N. C.
" armillatus.	
" gemma.	
Urosalpinx cinerea.	
Voluta mutabilis,	N. C.
" Trenholmii,	N. C.
Vermetus anguina.	

NORTH CAROLINA.

Cancellaria Carolinensis.	
= C. reticulata,	S. C.
Cæcum annulatum.	
Cerithium moniliferum.	
" (Cerithiopsis) annulatum.	
Cerithium bicostatum.	
Chemnitzia subulata.	
Conus adversarius,	S. C.
" diluvianus,	S. C.
Crucibulum multilineatum,	S. C.
" costatum,	S. C.
" ramosum,	S. C.
" dumosum,	S. C.
Cypræa Carolinensis,	S. C.
Crepidula fornicata,	S. C.
" spinosa,	S. C.
= C. aculeata.	
" plana,	S. C.
C. unguiformis.	
Carinorbis (Delphinula) quadricostata.	
Dentalium attenuatum,	S. C.
= D. dentale.	
" thallus,	S. C.
Dolium octocostatus.	
Ecphora quadricostata,	S. C.
Eulima (?) lævigata.	
Erato lævis?	
Fasciolaria distans,	S. C.
= F. tulipa.	
" elegans.	
" Sparrowi.	
" alternata.	
" nodulosa.	
" acuta.	
Fulgur carica,	S. C.
" contrarius.	
= F. perversus,	S. C.
" canaliculatus,	S. C.
? F. rugosus.	
" Carolinensis.	
= F. excavatus,	S. C.

Fulgur pyrum.	
= F. spiratus,	S. C.
Ficus reticulatus,	S. C.
Fusus exilis,	S. C.
" equalis.	
" lamellosus.	
" moniliformis.	
Fissurella redimicula,	S. C.
Galeodia Hodgei,	S. C.
Infundibulum centralis,	S. C.
Littorina lineata.	
Marginella limatula,	S. C.
" oliviformis,	S. C.
" constricta.	
" ovata.	
" inflexa.	
" elevata.	
Mitra Carolinensis,	S. C.
Murex umbrifer,	S. C.
" globosa.	
Natica heros,	S. C.
" duplicata,	S. C.
" canrena,	S. C.
" fragilis.	
" percallosa.	
" Emmonsii.	
Nassa vibex,	S. C.
" trivittata,	S. C.
" obsoleta,	S. C.
" (Tritia) multilineatum.	
" " moniliformis.	
" " bidentata.	
Obeliscus arenosa,	S. C.
Oliva literata,	S. C.
Oliva ancillariæformis.	
" canaliculata.	
Pleurotoma lunata,	S. C.
" limatula.	
" communis.	
" elegans.	
" tuberculata.	
" flexuosa.	
Ptychosalpinx porcinum,	S. C.
" multirugatum,	S. C.
Petaloconchus sculpturatus,	S. C.
Pyramidella reticulata.	
Ranella caudata,	S. C.
Scalaria multistriata,	S. C.
" clathra,	S. C.
" curta.	
Terebra Carolinensis,	S. C.
" unilineata,	S. C.
" neglecta.	
Tornatina cylindra.	
Trivia pediculus,	S. C.
Turritella Burdenii,	S. C.
" Etiwænsis,	S. C.
" constricta.	
Turbonilla reticulata.	
Trochus philantropus,	S. C.
Voluta mutabilis,	S. C.
" Trenholmii,	S. C.
" obtusa.	
Helix tridentata.	
" labyrinthica.	
Planorbis bicarinatus.	
Paludina subglobosa.	

A comparison of the two preceding tables shows, that of the 74 South Carolina forms no less than 52 (or 70 per cent.) are common to the deposits of North Carolina, a proportion very nearly identical with that which obtains in the case of the acephalous mollusks (74 per cent.). This very close agreement leaves but little, if any, room for doubt as to the contemporaneity of the formations of the two States. In North Carolina the number of specific forms described is considerably in excess of that from the former State, and consequently, as must almost necessarily follow, the percentage of common forms is here very materially reduced.

Thus of 100 species—4 of which are non-marine—only 52, as above stated, also occur in South Carolina, or just 52 per cent. It is but fair to presume, however, that were the number of species described from South Carolina equal to that from North Carolina the proportion of forms common to the two States while it would not probably differ very materially from what we now find it in the former State, would be considerably raised for the latter. On the other hand, just the reverse result presents itself when a comparison is made with the Virginia fauna, which comprises a far greater number of species than is to be found in any other State:

Virginia.

Amycla reticulata.
Actæon (?) milium.
Adeorbis (Delphinula) costulata.
" " concava. (A. lipara).
" " obliqué-striata.
Anguinella Virginiana.
Bela Dædalia.
Buccinum Tuomeyi.
" frumentum.
Crepidula costata, S. C.
" fornicata, S. C.; N. C.
" spinosa, S. C.; N. C.
" ponderosa.
" cornucopiæ.
" cymbiformis.
Crucibulum costatum, S. C.; N. C. (Calyptrea pileolus).
" ramosum, S. C.; N. C.
" grande.
Cemoria oblonga.
Capulus lugubris.
Cancellaria perspectiva.
" plagiostoma.
Cerithium clavulus.
" curtum.
Cerithiopsis annulatum, N. C.
Chiton transenna.
Cylichna cylindrica.
" Virginiana.
Chemnitzia (Pasithea) subula, N.C.
" " exarata.
" " eburnea.
Dentalium thallus, S. C.; N. C.
" attenuatum, S.C.; N.C. = D. dentale.
Delphinula trochiformis.
" (Carinorbis) arenosa.
" lyra.
Ecphora quadricostata, S.C.; N.C.
Eulima (Pasithea) lævigata, N.C.
" eborea.
" migrans.
Eulimella (Pasithea) ovulum. (E. diaphana).
Fasciolaria parvula.
" rhomboidea, S. C.; N. C. = F. distans.
Fissurella redimicula, S. C.; N. C.
" catilliformis.
Fulgur carica, S. C.; N. C.
" canaliculatus, S. C.; N. C.
" incile (Conradi), S. C.
" tritonis.
" filosus.
" carinatus.
" maximus.
Fusus (Neptunea) exilis, S. C.; N. C.
" strumosus.
" (Neptunea) trossula.
Marginella limatula, S. C.; N. C.
" perpusilla.
" conulus.
" exilis.

Marginella eburneola.
Mangelia Virginiana.
Menestho limnea.
Melampus (?) longidens.
Nassa trivittata, S. C.; N. C.
" impressa.
" (Tritia) altilis.
" bilix.
" " laqueata.
Natica duplicata, S. C.; N. C.
" heros, S. C.; N. C.
" aperta, N. C.
(N. fragilis ?).
" sphærula, N. C.
(N. percallosa ?).
" perspectiva.
Niso lineata.
Oliva canaliculata, N. C.
" ancillariæformis, N. C.
" Carolinensis.
= O. literata, S. C.; N. C.
" eborea.
Obeliscus arenosa, S. C.; N. C.
(Pyramidella suturalis).
Odostomia (Actæon) granulatus.
" (?) globosus.
" " turbinatus.
" " angulatus.
" " glans.
" " sculptus.
" " nitens.
Patella acinaces.
Petaloconchus sculpturatus,
S. C.; N. C.
Pleurotoma lunata, S. C.; N. C.
" pyrenoides.
" (Drillia) multisecta.
" " arata.
" " bella.
" " distans.
" " dissimilis.
" " eburnea.
" " impressa.
" (Surcula) engonata.
" " nodulifera.
Pleurotoma (Surcula) tricenaria.
" " Virginiana.
Pyramidella elaborata.
Ptychosalpinx porcinum,
S. C.; N. C.
Rotella nana.
" subconica.
" carinata.
" lenticularis.
" umbilicata.
Scalaria clathra, S. C.; N. C.
" = S. angulata.
" acicula.
" micropleura.
" microstoma
(S. cornigera ?).
" pachypleura.
" procera.
Solarium nupera.
Trochus philanthropus, S.C.; N.C.
" armillus.
" conus.
" lens.
" torquatus.
" Ruffinii.
" bellus.
" labrosus.
" Mitchelii.
Turbo rusticus.
" (Monilea) caperata.
Trophon tetricus.
Turritella variabilis.
" indenta.
" plebeia.
" alticosta.
" flexionalis.
" terstriata.
" bipertita.
Trochita (Infundibulum)
concentrica.
Triforis (Cerithium) monilifera.
Urosalpinx cinerea.
Vermetus convolutus.
Voluta mutabilis, S. C.; N. C.
Vivipara (Turbo) glaber.

NOTE.—Several species described by H. C. Lea (Amer. Philos. Trans.,

new ser., vol. ix), considered to have been founded on insufficiently determined characters, or on the immature forms of previously described species, have been intentionally omitted.

We find that of the 141 species here enumerated only about 26 are found in the deposits of South Carolina, which would give to that State a comparatively low percentage of common forms (35), and one considerably less than that (42) which was found to exist when the acephalous mollusks were taken as the basis of comparison. Nor is the number of Virginia forms (31) occurring in North Carolina much more numerous, and here, likewise, the percentage (31) is markedly lower than was found to be the case (46) in the first method of comparison. Taking these various facts together they are abundantly conclusive as to the correctness of the inference drawn from the testimony of the lamellibranchs, that the Virginia deposits represent a horizon different from that indicated by the South and North Carolina formations.

From the Maryland deposits taken as a whole, *i. e.*, as comprising both the "newer" and "older" groups, there have thus far been described about 105 species of gasteropodous mollusks; of these, as will be seen from the following table, about 21 (20 per cent.) also occur in South Carolina, and 26 (or 25 per cent.) in Virginia. While the proportion of forms common to the two States is thus shown to be very limited in either case, and decidedly less than was found to exist among the lamellibranchs, there is yet (as was also indicated in the lamellibranch comparisons) a slight advantage in favor of Virginia.

Maryland—Newer Group.

Actæon ovoides.
" melanoides.
Bulla (?) acuminata.
Cancellaria corbula.
" lunata.
" alternata.
Cassis (Semicassis) cælata.
Crucibulum grande, Va.
" tubiferum.
" costatum, S. C.; N. C.; Va.
Conus diluvianus, S. C.; N. C.
" Marylandicus.
Columbella communis.
" avara, S. C.
Dentalium thalloides.
" attenuatum, S. C.; N. C. Va.; = D. dentale.
Ecphora quadricostata, S. C.; N. C.; Va.
Fusus (Neptunea) parilis.
" " errans (rusticus).
" sulcosus.
" strumosus, Va.
Fissurella alticosta.
" nassula.
" redimicula, S. C.; N. C.; Va.
Fulgur rugosus?

Fulgur coronatus.
" canaliculatus, S. C.; N. C.; Va.
" tuberculatus.
" carica, S. C.; N. C.; Va.
" fusiformis.
" alveatus?
Ficus? (Pyrula) sulcosa.
Marginella denticulata.
Melanopsis (Bulliopsis) ovata.
" integra, Va.?
" Marylandica.
Natica interna.
" duplicata, S. C.; N. C.; Va.
" heros, S. C.; N. C.; Va.
" fragilis, N. C.; Va.
Nassa trivittata, S. C.; N. C.; Va.
" obsoleta, S. C.; N. C.
" lunata, S. C.
" quadrata.
" prærupta.
" porcinum, S. C.; Va.
" arata.
Pleurotoma bicatenaria.
" limatula, N. C
" communis, N. C.
" parva.
" rotifera.
Pleurotoma gracilis.
" dissimilis, Va.
Ranelia centrosa, S. C.? N. C.?
= R. caudata?
Scalaria clathra, S. C.; N. C.; Va.
= S. angulata.
" expansa.
Terebra simplex.
" curvilineata.
" loxonema.
Trochus humilis.
" reclusus.
" Bryanii.
Turbo (Monilea) distans.
" " eborea.
Turritella plebeia, Va.
" variabilis, Va.
" laqueata.
" solitaria.
" alticosta, Va.
" octonaria.
Turbinella demissa.
Turbonilla perlaqueata.
Trophon tetricus, Va.
Typhis acuticostata.
Urosalpinx cinerea, S. C.; Va.
Voluta mutabilis, S. C.; N. C.; Va.
" solitaria.

Maryland—Older Group.

Buccinum? protractum.
" lienosum.
Bulla subspissa.
Cancellaria biplicifera.
" engonata.
Crucibulum ramosum, S. C.; N. C.; Va.
" constrictum.
Dentalium thalloides.
Fissurella Marylandica.
Fusus migrans.
" (Neptunea) devexus.
Marginella perexigua.
Niso lineata, Va.
Pleurotoma Marylandica.
" bellacrenata.
" rugata.
Scalaria pachypleura, Va.
Solarium trilineatum.
Sigaretus fragilis.
Trochita (Infundibulum) perarmata.
Turritella indenta, Va.
" exaltata, S. C.
" perlaqueata.
Trochus peralveatus.
Valvula iota.
Voluta mutabilis, S. C.; N. C.; Va.
" solitaria.

Taking each of the two Maryland divisions, already referred to,

by itself, we find that of the 21 forms occurring also in South Carolina, 19 belong to the deposits of the "newer" group, which comprise in all about 78 species; the percentage of forms common to the two formations—25—is thus considerably above that which was found to obtain when the State formation was considered as a whole. And the same increased percentage is determined when the Virginia forms are considered. Of the 26 indicated in the preceding enumeration, 22 belong to the "newer" group, of whose fauna they consequently constitute 28 per cent. The 27 species belonging to the "older" group have only 3 (or 10 per cent.) common with South Carolina, and 5 (or 18 per cent.) common with Virginia. In comparing the gasteropod faunas of the two Maryland divisions with each other, we find that there are only three species whose range embraces the deposits of both series. From the preceding data it will be seen that very strong confirmation is lent to the conclusions derived from the examination of the lamellibranch fauna as to the non-contemporaneity of the South Carolina (*et conseq.*, North Carolina) deposits with those of Virginia and Maryland, and to the existence of two well-marked faunal horizons in the last named State. No conclusive evidence is, however, afforded relative to the position which the Virginia and Maryland deposits hold in respect of each other; for the determination of this point, as well as for the determination of the several horizons, testimony must again be sought in the relations which the extinct faunas bear to the fauna of existing seas.

Species still living found in the South Carolina deposits :

Dentalium attenuatum = D. dentale.
Crepidula fornicata.
" spinosa = C. aculeata.
" plana = C. unguiformis.
Natic heros (N. catenoides).
" duplicata.
" canrena (N. plicatella).
Littorina irrorata (L. Carolinensis).
? Solarium perspectivum.
Scalaria multistriata.
" clathrus = S. angulata.
Obeliscus arenosa.
Trivia pediculus.
Nassa vibex.
" trivittata.
" obsoleta.

Dolium galea.
Columbella avara.
Oliva literata (O. Carolinensis).
Ranella (Bursa) caudata.
Cancellaria reticulata (C. Carolinensis).
Fulgur carica.
" perversum (F. adversarium).
" canaliculatum (F. canaliferum).
" pyrum.
Urosalpinx cinerea (Peristernia filicata).
Fasciolaria distans (F. rhomboidea) — F. tulipa.

NOTE.—Three or four additional species, for several reasons here omitted, may, on further examination, be found to be identical with recent forms.

Thus out of a total number of 74 species about 27 are still found living at the present day; the percentage of recent to extinct species—37—is therefore not very different from that which was found to obtain among the acephalous mollusks.

The following recent species may be considered to occur in North Carolina:

Dentalium attenuatum — D. dentale.
Crepidula fornicata.
" spinosa — C. aculeata.
" plana — C. unguiformis.
Natica heros (N. catenoides).
" duplicata.
Natica canrena (N. plicatella).
Scalaria multistriata.
" clathrus = S. angulata.
Obeliscus arenosa.
Trivia pediculus.
Nassa vibex.
" trivittata.
" obsoleta.
Olva literata (O. Carolinensis).
Ranella (Bursa) caudata.
Cancellaria reticulata (C. Carolinensis).
Fulgur carica.
" perversum (F. contrarium).
" canaliculatum.
" pyrum (F. spirata).
Fasciolaria distans — F. tulipa.

All of the above 22 species, which constitute 22 per cent. of the

gasteropod fauna of the State, are found also in South Carolina. We have here, just as in the case of the lamellibranch fauna, a decided decrease when compared with the last mentioned State in the proportion of living forms, but yet, as before, the very well marked correspondence or identity existing generally between the two faunas would preclude the supposition of the representation by them of two distinct horizons.

In Virginia and Maryland the number of recent species is considerably less than in either South or North Carolina, and the proportion these bear to extinct forms is also very materially reduced. Thus of about 141 Virginia species only 12 (or $8\frac{1}{2}$ per cent.) can be considered as being identical with living forms, namely:

Dentalium attenuatum = D. dentale.
Crepidula fornicata.
" spinosa — C. aculeata.
Natica duplicata.
" heros (N. catenoides).
Fulgur carica.
" canaliculata.
O. Carolinensis — O. literata.
Scalaria clathra = S. angulata.
Nassa trivittata.
Obeliscus arenosa (Pyramidella suturalis).
Urosalpinx cinerea.

The number of recent species occurring in the Maryland deposits is about equal to that from Virginia; but here, owing to the limited extent of the fauna, the proportion to extinct forms is considerably increased. It is a significant fact that all the recent species belong to the "newer" group, and none to the "older." They are as follows:

Columbella avara.
Fulgur carica.
" canaliculata.
Urosalpinx cinerea.
Dentalium attenuatum — D. dentale.
Nassa trivittata.
" obsoleta.
Natica duplicata.
" heros (N. catenoides).
Scalaria clathra — S. angulata.
? Ranella centrosa — R. (Bursa) caudata ?

The percentage of recent forms is here, therefore, brought up to fourteen, or very nearly that (15), which obtains among the Virginia lamellibranchs, and 4 per cent. below that which was found to characterize the lamellibranch fauna for the same group of deposits.

Summing up the results obtained from the examination of the gasteropod fauna, we find that—

Of about 74 South Carolina species—

52 are found in North Carolina = 70 per cent.
26 are found in Virginia = 35 per cent.
21 are found in Maryland = 29 per cent.
27 are recent = 37 per cent.

Of about 100 North Carolina species—

52 are found in South Carolina = 52 per cent.
31 are found in Virginia = 31 per cent.
18 are found in Maryland = 18 per cent.
22 are recent = 22 per cent.

Of about 141 Virginia species—

26 are found in South Carolina = 19 per cent.
31 are found in North Carolina = 22 per cent.
26 are found in Maryland = 19 per cent.
12 are recent = 8½ per cent.

Of about 105 Maryland species—

21 are found in South Carolina = 20 per cent.
18 are found in North Carolina = 17 per cent.
26 are found in Virginia = 25 per cent.
11 are recent = 11 per cent.

Of about 78 Maryland "Newer" group species—

19 are found in South Carolina = 25 per cent.
17 are found in North Carolina = 22 per cent.
22 are found in Virginia = 28 per cent.
11 are recent = 14 per cent.

Of about 27 Maryland "Older" group species—

3 are found in South Carolina = 10 per cent.
2 are found in North Carolina = 8 per cent.
5 are found in Virginia = 19 per cent.
0 recent.

It will be readily perceived from the preceding summarized statement, that the general results obtained from the examination of the gasteropod faunas abundantly confirm the conclusions drawn from the study of the acephalous mollusks. Combining the results obtained from the two methods of comparison, we find that:

Of about 177 South Carolina mollusca—
- 128 are found in North Carolina = 72 per cent.
- 69 are found in Virginia = 39 per cent.
- 55 are found in Maryland = 31 per cent.
- 61–67 are recent = 35–38 per cent.

Of about 206 North Carolina mollusca—
- 128 are found in South Carolina = 62 per cent.
- 79 are found in Virginia = 38 per cent.
- 54 are found in Maryland = 26 per cent.
- 54 are recent = 26 per cent.

Of about 250 Virginia mollusca—
- 69 are found in South Carolina = 28 per cent.
- 79 are found in North Carolina = 32 per cent.
- 67 are found in Maryland = 27 per cent.
- 28 are recent = 11 per cent.

Of about 203 Maryland mollusca—
- 55 are found in South Carolina = 27 per cent.
- 54 are found in North Carolina = 27 per cent.
- 67 are found in Virginia = 33 per cent.
- 24 are recent = 12 per cent.

Of about 144 Maryland "Newer" group mollusca—
- 52 are found in South Carolina = 36 per cent.
- 49 are found in North Carolina = 34 per cent.
- 59 are found in Virginia = 41 per cent.
- 23 are recent = 16 per cent.

Of about 59 Maryland "Older" group mollusca—
- 7 are found in South Carolina = 12 per cent.
- 9 are found in North Carolina = 15 per cent.
- 13 are found in Virginia = 22 per cent.
- 2 are recent = 4 per cent.

Summary.

The following points in stratigraphy, it is believed, may be considered as being conclusively demonstrated through the foregoing comparisons :

1. That the South and North Carolina deposits represent approximately the same geological horizon ;

2. That the Virginia deposits indicate a horizon lower (older) in the geological scale than that of either of the formations just mentioned ;

3. That the Maryland deposits indicate two well-marked faunal horizons, of which the upper one is the correspondent of the Virginian.

REMARK.—It will be seen from the last table that the correspondence existing generally between the Maryland deposits taken as a whole (i. e., including both "newer" and "older" groups) and those of Virginia, is greater than that which obtains between the last and the deposits of the "newer" group (upper Maryland horizon) considered alone, and, hence, it might readily be concluded that the Virginia and Maryland formations are absolutely equivalents of each other. But, as it has already been shown, the Maryland deposits almost unquestionably represent two well-defined faunal horizons, and, therefore, unless such is likewise found to be the case in Virginia—which *appears to be highly probable*, although evidence proving the same is still insufficient—no general correlation can be insisted upon.

Having ascertained the relations which the deposits of the several States hold towards each other, it remains lastly to determine what are the horizons, as generally recognized by geologists, that they represent. The low percentage of living forms which characterizes the molluscan faunas of the Maryland and Virginia deposits leaves no doubt as to the miocene age of these last ; the "older" group of Maryland, therefore, represents the base of the miocene series. As for the North and South Carolina deposits, their position is somewhat more difficult to pronounce upon. The percentage of recent forms occurring in South Carolina is

such as to permit, according to the original Lyellian classification of the tertiary strata, of the deposits of that State being referred to the pliocene period. The North Carolina deposits, on the other hand, would according to the same system of classification be relegated to the miocene period, and yet, as has already been seen, the identity existing between the faunas of the two States is altogether too great to admit of any reasonable doubt as to their contemporaneity. Nor is the difficulty of determination lessened when an appeal is made to European deposits of nearly similar age, which have served to elucidate the principles of the Lyellian classification. Thus in what might be considered to be the two typical areas for the occurrence of marine pliocene deposits in Europe—Italy and England—the percentages of recent forms characterizing the contained faunas vary within very broad limits. Foresti has shown (*vide* Fuchs, *Die Gliederung der Tertiärbildungen am Nordabhange der Apenninen von Ancona bis Bologna*, Sitzb. d. k. Akademie der Wissenschaften, lxxi, p. 177, Vienna, 1875) that the so-called pliocene of the Bolognese Apennines may be divided into four faunal horizons, the deposits belonging to which are characterized by the following percentages of recent forms:

	Total number of species.	Living.	Percentage of living forms.
IV.	141	112	79.4
III.	332	144	43.3
II.	183	71	38.8
(Oldest) I.	78	24	30.7

Nos. I and II, therefore, correspond very closely in the proportion of living forms with the North and South Carolina deposits. But just this division of the sub-Apennine formation, or its equivalent, is by many Italian geologists referred to the upper miocene, and, indeed, it would appear more natural, if the percentage of living forms is to remain the principal basis for the classification of the tertiary formations, to group the doubtful deposits here, and thereby increase the latitude of the miocene, than where they have very generally been placed, unless, as would seem from the observations of Pareto (*Les terrains tertiaires de l'Apennin septentrional*, Bulletin de la Société Géologique de France, 2d ser., vol. xxii, 1864-5, p. 237, *et seq.*), and Fuchs (*loc. cit.*), strati-

graphical evidence is decidedly contrary to such an approximation.[1] In the English pliocene faunas the percentages of recent forms are very much higher than in the Italian just referred to.[2] The following table exhibits the numerical relations of the living and extinct species, which together constitute the crag molluscan fauna (Lyell, "Student's Elements of Geology," 1878, p. 183, *emend*):

NEWER PLIOCENE.

	Total number of species.	Living.	Percentage of recent forms.
Chillesford beds,	88	74	84.1
Norwich, (Fluvio-marine),	112	94	84

OLDER PLIOCENE.

Red Crag, (exclusive of derivatives),	248	179	72.2
Coralline Crag,	396	252	63.6

It will thus be seen that the number of recent forms occurring in the *oldest* division of the British pliocene deposits is, proportionately to the extinct species, very much greater—in fact, not far from twice as great—than that which has been found to exist

[1] A direct continuity between the upper miocene (Tortonian) and the Bolognese sub-Apennine (pliocene of most authors) formations is maintained by Capellini (Sui Terreni Terziari di una parte del versante settentrionale dell 'Apennino, Mem. Accad. Scienze, Istit. Bologna, ser. iii, vol. vi, p. 618, 1876). Under the strata designated as the mio-pliocene ("Messinian" of Mayer), corresponding in a general way with the "Sarmatian" and "Congerian" of the Austrian geologists, and consequently comprising (as generally recognized by geologists) deposits of both miocene and pliocene age, are included I and II of Foresti's faunal horizons—the lower sub-Apennine marls and sands of Capellini (upper Messinian of Mayer). The upper marls and sands (III and IV) are referred to the "Astian" (or pliocene proper of Capellini). This classification appears to be more in consonance with the facts presented by paleontology than the one usually followed.

[2] Foresti has called attention (*Catalogo dei Molluschi Pliocenici delle Colline Bolognesi*, Mem. Accad. Scienze, Istit. Bologna, ser. ii, vol. vii, p. 548, 1867) to the much greater relationship which the fauna of the Bolognese sub-Apennine formations bears to the fauna of the Vienna basin than to that of the British crag, and from this circumstance draws the inference, that the Italian deposits represent a horizon very close to the miocene ("*rapresentano un plano geologico vicinissimo al miocene,*" . . .).

in the case of the South Carolina deposits. While it may be safe to affirm, from this disparity existing between the American and English faunas, that the formations represented by them are in no way equivalents of each other, (an equivalency, as has already been stated, that had been assumed by Lyell), it may yet be rash to conclude from this reason alone that, broadly measured, they do not belong to the same period (pliocene) of geological time, the more especially, since (as will be seen from a comparison of the British and Italian faunal tables) a nearly equal disparity obtains between the faunas of the Crag and some of the sub-Apennine deposits considered to belong to the same period. Nor would it be safe to affirm conclusively, although the evidence in this direction may be considered to be sufficiently strong, that the American deposits in question are correlative of that portion of the sub-Apennine formation, which, by some geologists, has been referred to the upper miocene, or classed as mio-pliocene. While it may thus be difficult to determine *absolutely* whether the South Carolina deposits (and, consequently, also the North Carolinian) ought to be classed as pliocene or miocene, yet, in view of the fact that thus far no tertiary beds have been discovered in that State, nor probably anywhere else along the Atlantic coast, whose fauna more closely approximates that of the present day, and the broad hiatus that is thus created between them and the succeeding post-pliocene, in which, as determined by Holmes ("Post-Pleiocene Fossils of South Carolina," 1860, Introduc., pp. 3 and 4), the recent forms make up fully 99 per cent. of the molluscan fauna,[1] it would appear more natural to group them in the same series with the deposits of Virginia and Maryland, to which, as has been demonstrated by the tables of comparisons, they bear a strong relation. For these reasons the author has preferred to consider them as being of miocene age, and as representing the uppermost member of the series.[2] The miocene deposits of the Atlantic slope would, according to this determination, be divisible into three groups:

[1] I have had no opportunity as yet of verifying this statement.

[2] But very little evidence as to stratigraphical position is afforded by direct comparisons made between the European and American faunas, since the number of equivalent, or even representative forms is comparatively limited, and these are about equally divided between the European miocene and pliocene. The following South Carolina lamellibranchs may

Upper Atlantic miocene, represented by the South and North Carolina deposits.

Middle Atlantic miocene, represented by the whole, or the greater part of the Virginia deposits, and those of the Maryland "newer" group.

Lower Atlantic miocene, represented by the deposits of the Maryland "older" group, and possibly the lower portion of the Virginia formation.

To these three groups, commencing with the oldest, it is proposed to apply the designations of "Marylandian," "Virginian," and "Carolinian," respectively.

The sequence of the tertiary formations along the Atlantic and Gulf slopes of the United States would, therefore, be approximately as follows:

be considered to occur, or to have their analogues in the crag (pliocene) deposits:

Anomia ephippium.
Ostrea Virginiana, represented by O. edulis.
Lucina filosa — L. borealis.
" crenulata.
Lucina dentata?
Nucula obliqua = Nucula nucleus?
Astarte bella, represented by Astarte gracilis.
" undulata, represented by A. Omalii.
Artemis intermedia, represented by A. lentiformis.
Mactra lateralis, represented by Mactra ovalis.
Solen ensis.
Pandora trilineata — P. inequivalvis?

The following may be said to occur, or to have their analogues in the deposits of the Vienna basin:

Anomia ephippium, represented by A. costata.
Arca plicatura, represented by A. diluvii.
Nucula obliqua = N. nucleus?
Lucina squamosa = L. pecten (reticulata).
" filosa — L. borealis.
" anodonta = L. Miocenica?
" divaricata, represented by L. ornata?
Chama corticosa, represented by C. gryphina.
Cardium magnum, represented by C. Kübeckii.
Artemis intermedia, represented by A. lentiformis.
Pandora trilineata — P. inequivalvis?

POST-PLIOCENE.			
PLIOCENE.	?	?	
MIOCENE.	CAROLINIAN (Upper Atlantic Miocene).	Deposits of South and North Carolina ("Sumter" epoch of Dana).	
	VIRGINIAN (Middle Atlantic Miocene).	Deposits of Virginia, and of the "Newer" group of Maryland ("Yorktown" epoch, in part, of Dana).	Probably of the age of the "Second Mediterranean" of the Austrian geologists, and of the faluns of Touraine.
	MARYLANDIAN (Lower Atlantic Miocene).	Deposits of the "Older" group of Maryland, and possibly the lower Miocene beds of Virginia ("Yorktown" epoch, in part, of Dana).	Probably (or at least partially) the equivalent of the "First Mediterranean" of the Austrian geologists, and of the faluns of Léognan and Saucats.
OLIGOCENE.	ORBITOITIC.	Strata characterized by species of *Orbitoides*, etc. Vicksburg beds, Florida beds, etc.	
EOCENE.	JACKSONIAN.	Jackson beds of Mississippi—"White Limestone" of Alabama.	
	CLAIBORNIAN.	Fossiliferous arenaceous deposit of Claiborne, Ala., etc.	Age of the "Calcaire Grossier" of France (Parisian).
	BUHRSTONE.	Beds below the true Claibornian on the Alabama River. "Chalk Hills" of the southern part of the State, etc. "Siliceous Claiborne" (Hilgard) of Mississippi.	Londonian?
	EO-LIGNITIC.	Lignite, sands, and clays situated at the base of the Tertiary series in Alabama, etc. Eocene beds of Maryland?	Thanetian?

REMARK.—In the above table, in most instances, only the *more prominent* localities for the occurrence of the several deposits have been given, and the absence of reference to certain States, therefore, does not indicate that deposits of a given age are there wanting. The "Jacksonian" beds, which are generally placed at the top of the eocene series, may, on further examination, prove to be oligocene. By some geologists a portion of the post-eocene tertiary deposits of New Jersey, Delaware and Maryland has been referred to the pliocene period, but there does not appear to be as yet sufficient evidence to support such a conclusion. No precise correlation between the entire series of the Atlantic tertiary deposits of the United States and those of Europe can thus far be said to have been determined. There can be no doubt as to the parallelism existing between the Claibornian and the "Calcaire Grossier" (Parisian) of France; but as for the immediately overlying and underlying eocene deposits, their relations can only be approximately fixed from the positions which they occupy in their own series. The "Buhrstone" appears to represent a portion, or perhaps even a greater part of the "Londonian," and the Marlborough and Piscataway beds of Maryland (eo-lignitic?), a horizon probably not far removed from that of the Bracheux sands of the Paris basin, or the Thanet sands of England (Thanetian).[1] The exact equivalents of the "Orbitoitic" have not yet been satisfactorily made out. There can be little or no doubt respecting the position of the "Virginian," whose faunal facies places it at about the horizon of the faluns of Touraine, and the "Second Mediterranean" beds of the Vienna basin; nor can there be much more doubt as to the equivalency, at least in part, of the "Marylandian" and the lower miocene beds of the Vienna basin ("First Mediterranean").[2]

[1] Heilprin, Proc. Acad. Nat. Sciences, 1881, p. 446.

[2] The proportions which the recent species of mollusca bear to the extinct forms is larger in the *older* deposits of the Vienna basin than in the newer; the percentages for the two divisions of the "Mediterranean" are twenty-one for the "First," and fifteen for the "Second" (Fuchs, *Geologische Uebersicht der jüngeren Tertiärbildungen des Wiener Beckens.* Führer zu den Excursionen der D. Geolog. Gesellschaft, Vienna, 1877, p. 103). The following species of Virginia and Maryland lamellibranchiata may be con-

The relations of the "Carolinian" have already been fully discussed.[1]

sidered as occurring, or having their analogous in the deposits of the Vienna basin and the British crag:

VIENNA BASIN.

Saxicava rugosa (bilineata) = S. arctica.
Panopæa Americana, represented by P. Menardi.
Venus latilirata, represented by V. scalaris?
Isocardia fraterna, represented by I. cor.
Chama corticosa, represented by C. gryphina.
Lucina anodonta — L. Miocenica?
" contracta (filosa) = L. borealis.
" divaricata, represented by L. ornata.
" squamosa (speciosa) — L. pecten (reticulata).
Nucula obliqua — N. nucleus?
Arca plicatura, represented by A. diluvii.
Myoconcha incurva, represented by Mytilus Haidingeri?
Perna maxillata — P. Soldanii.

CRAG.

Ostrea Virginiana, represented by O. edulis.
Lucina filosa (contracta) = L. borealis.
" crenulata (Conrad) = L. crenulata (Wood)?
" dentata.
Nucula obliqua — N. nucleus?
Erycinella ovalis.
Astarte undulata, represented by A. Omalii.
Panopæa Americana, represented by P. Menardi.
" porrecta = P. gentilis?
Pandora arenosa (trilineata *pars?*), represented by P. pinna.
Saxicava rugosa.
Isocardia fraterna, represented by I. cor.

[1] It is not improbable that the age of the beds of this period will be most nearly represented by that of the deposits of the lower ("Black") Antwerp Crag (Diestian), considered by most Belgian geologists to form the base of the pliocene series of that country (Dewalque, *Prodrome d'une Description Géologique de la Belgique*, 1880, p. 254), and by Lyell ("Student's Elements," p. 185), as the "first links of a downward passage from the strata of the pliocene to those of the upper miocene period." The percentage (46) of recent molluscan forms characterizing the fauna of these Belgian deposits, as determined by Lyell in 1852 ("On the Tertiary Strata of Belgium and French Flanders," Journ. Geol. Soc. London, VIII., p. 293), is, however, considerably higher than that which has been shown to be the case with the Carolinian fauna.

JUNE 20.

The President, DR. LEIDY, in the chair.

Twenty-nine persons present.

A paper entitled "On the occurrence of Nummulitic Deposits in Florida, and the association of Nummulites with a fresh-water Fauna," by Angelo Heilprin, was presented for publication.

JUNE 27.

Rev. Henry C. McCook, D.D., Vice-President, in the chair.

Twenty-two persons present.

The following papers were presented for publication :—

"On supposed Tertiary Ammonites," by J. S. Newberry.

"On the age of the Tejon Rocks of California and the occurrence of Ammonitic Remains in Tertiary Deposits," by Angelo Heilprin.

The death of Mrs. Eleanor P. Long, a member, was announced.

Distribution of Nerves.—Dr. HARRISON ALLEN called attention to the nerves as they were found in birds and other animals. He had detected that the arrangement of the follicles for the feathers (*pteryls*), an account of which Nitzsch has elaborated in his memoir on Pterylography, was associated with peculiarities of distribution of the cutaneous nerves, and it was held by the speaker that a careful study of these nerves, in mammals as well as birds, would result in the elucidation of some interesting points in connection with the trophic nerves of the integument. He further spoke of the arrangement of the nerves in the anterior extremity of the mammal. He had found the deeper muscles, such as the Pronator Quadratus and Anconeus, supplied by long nerves, while the superficial muscles were supplied by much shorter ones. In *Menopoma* he had detected a branch of the ulnar nerve passing into the natatorial fold of skin present on the ulnar border of the forearm. He had found in this genus the musculo-spiral nerve and the ulnar nerve to arise from the same trunk, and suggested, as probable, that the deep conjunctions of these nerves in the brachial plexus of man would be found to be a constant one. The ulnar nerve is one of the most interesting in the series, and might be called the *manal nerve* since it is distributed entirely to

the hand and the muscles influencing it, and is well developed in forms in which the median is undeveloped. The muscles of the forearm, to which the ulnar nerve goes—the Flexor Carpi Ulnaris, and the ulnar portion of the Flexor Profundus Digitorum—are among the most interesting muscles in the limb. Both muscles are singularly constant. They are the most effective muscles in the backward movement of the manus in swimming and in walking, and in the case of the Flexor Carpi Ulnaris, in making tense that portion of the wing membrane of the bat lying between the manus and the side of the body. The course of some of the cutaneous nerves of the manus in the bat is indicated by raised folds of the integument, which, when present, have systemic significance.

Mr. Henry Howson was elected a member.

July 4.

Mr. Meehan, Vice-President, in the chair.

Eleven persons present.

The death of Chas. L. Sharpless and that of Joseph Swift, members, were announced.

The following were ordered to be published :—

ON THE OCCURRENCE OF NUMMULITIC DEPOSITS IN FLORIDA, AND THE ASSOCIATION OF NUMMULITES WITH A FRESH-WATER FAUNA.

BY ANGELO HEILPRIN.

Beside the so-called *Nummulites Mantelli* of Morton ("Synopsis Org. Rem. Cretac. Group," p. 45, 1834), a species now known to belong to the genus *Orbitoides*, only one other form of supposed Nummulite has been recorded as occurring fossil in any North American formation. This is the *Nummulites Floridanus* from the "upper Eocene limestone" of Tampa Bay, Florida, described by Conrad in Vol. II (new series) of the American Journal of Science and Arts" (1846). The species is there said to be abundant, and is referred to the subgenus *Assilina*[1] of D'Orbigny. The description given is brief, but at the same time very broad, and no reference of any kind is made to the internal chambers or the partitions of the test; nor does the figure appended to the description, which resembles a nummulite only in the circumferential outline, give the faintest indication of these characters. In fact, if Conrad's figure is at all carefully drawn, it would much more nearly indicate a species of the genus *Orbiculina* than of *Nummulites*. In the "Catalogue of the Eocene Annulata, Foraminifera, Echinodermata, and Cirrepedia of the United States," prepared by the same author (Proc. Acad. Nat. Sciences of Phila., vol. 17, p. 74, 1865) the form in question (*Cristellaria? Floridana* of D'Orbigny, *Prodrome de Paléontologie*, vol. II, p. 406) is referred to the new genus *Nemophora* of Conrad, the characters of which are not stated, and whose relations to *Nummulites*, if any such exist, are left to the imagination of the reader to determine.[2] In numerous specimens of rock fragments that have been kindly furnished from different parts of the State of Florida by Dr. Eugene A. Smith, State Geologist of

[1] By some authors the members of this group are considered to have distinctive characters sufficient to separate them as a genus apart from *Nummulites* (La Harpe, *Étude sur les Nummulites du Comté de Nice*, Bulletin de la Soc. Vaud. des Sc. Nat., vol. XVI, p. 211. 1879).

[2] As is the case with a very large proportion of Conrad's genera, no diagnosis of the "genus" *Nemophora* appears ever to have been furnished; at least, it has not been the good fortune of the writer to discover any such.

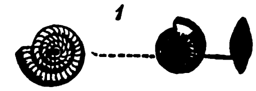
Alabama, and Mr. Joseph Willcox, of this city, the writer has carefully searched for foraminiferal remains that might with any amount of positiveness be identified with the form above referred to, but without success. While the *Operculina* (*Cristellaria!*) *rotella*, stated by Conrad (*loc. cit.*) to occur with the so-called Nummulite, was found in sufficiently great abundance in some of the rock fragments—in fact, largely entering into the composition of their incoherent masses—no trace of anything answerable to the latter could be detected, unless certain associated disciform bodies, measuring a quarter of an inch or more in diameter, and ornamented on the external surface with regular concentric lines of prominent granules, were actually the objects sought after.[1] But in these the spiral volutions represented by Conrad could not be detected, nor does that author make reference in his species to any external ornamentation consisting of granules. On the whole, we believe, it may be safely affirmed that the *Nemophora* had nothing in common with the genus *Nummulites* beyond a resemblance in outline, and the general community of character that would place all similar organisms in the one class of the foraminifera. The existence, therefore, of any fossil North American Nummulites may be considered to have been thus far at best but very doubtful.

But whatever doubt may have hitherto existed as to the occurrence of North American Nummulites, none such can any longer remain. From an examination of rock specimens that were recently obtained by Mr. Willcox from the western shore of the peninsula of Florida, the writer has been enabled to determine positively not only the existence there of these organisms, but their occurrence (locally) in such quantities as to constitute by their masses a true nummulitic rock. The rock in question is a white or yellowish-white friable limestone, found in the immediate neighborhood of the Cheeshowiska River, Hernando County, a few miles (4) from the coast line. The rock whence the fragments were obtained occupies a level not more than two feet above tide-water of the Gulf. All the specimens of Nummulites appear to belong to a single species, and to the sub-genus *Nummulina*, in which, as distinguished from *Assilina*, the individual whorls

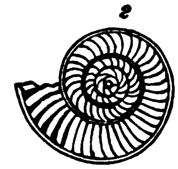
[1] These bodies appear to represent a new form of foraminiferal test, but their imperfect preservation precludes the possibility of a satisfactory diagnosis.

completely envelop each other, and to which the most characteristic foreign representatives of the genus—*N. lævigatus*, *N. complanatus*, *N. planulatus*, *N. intermedius*, etc., belong. The tests, varying in size up to about $\frac{1}{3}$ inch in diameter, are in an excellent state of preservation, and may be readily sliced open so as to show the internal structure. A central initial chamber is distinctly visible. To this species, belonging to the group of the *plicatæ* of D'Archiac, I would propose, from the name of its discoverer, the specific designation of *N. Willcoxi*.[1]

1



2



As to the age of the formation represented by these nummulitic deposits, there might appear to be at first sight no question of doubt. The presence alone of Nummulites in any formation is almost positive indication as to the eocene or oligocene age of that formation, and the more especially when the remains of these organisms occur in any abundance.[2] Admitting the supposition of this age, we should naturally look to the associated fossils for further confirmatory evidence bearing on this point. Singularly enough in the case of the Florida nummulitic rocks—at least in

[1] *Nummulites Willcoxi:* Test regularly rounded, tumid (more especially in the earlier stage), and measuring in the largest specimen about $\frac{1}{3}$ inch in diameter; external surface distinctly marked by the arcuate, and somewhat wavy outlines of the septal prolongations; volutions about 5, completely enveloping; septa close set, about 35–45 in the last whorl, and well flexed; central initial chamber distinctly visible.

While on further investigation this species may be found to be identical with one of the numerous forms described from the nummulitic deposits of Eur-Asia, from several of which it scarcely appears to differ, yet in the absence of actual specimens with which to institute direct comparisons, and the difficulty that attaches to the specific determination of this class of organisms, I have preferred to follow the safer course, and to describe it as distinct. According to Carpenter, Kitchen Parker and Rupert Jones, all the various "specifically distinct" forms described as belonging to the subgenus (or genus), *Nummulina*, of which, up to 1853, 55 were recognized by D'Archiac and Haime, are referable to a single species, which is consequently co-extensive with the genus (Carpenter, "Introduction to the study of the Foraminifera," Roy Soc. Rep., 1862, pp. 273–4).

[2] Nummulites are excessively rare in deposits newer (miocene or pliocene) than the oligocene.

the fragments that have been placed at my disposal—with very few exceptions all the molluscan remains belong to a period much more recent than the eocene, and to species that are still living at the present day. And what may appear still more singular, they are referable in principal part to land and fresh-water genera—*Glandina*, *Paludina*, *Ampullaria*.[1] From this association, and the circumstance that Nummulites are still met with in existing seas,[2] it might readily be inferred that there has been here a co-mingling of contemporaneous marine and fresh-water organisms, and that the deposits in question were laid down under such conditions—proximity to the mouth of a river—where a co-mingling of this kind could take place. Indeed, it would be difficult from paleontological evidence alone to disprove such an assumption, were it not that almost incontrovertible proof to the contrary in addition to that furnished by the *abundance* of Nummulites, is afforded in the presence of the remains of *Orbitoides*,[3] a genus which attained its greatest development in the upper eocene ("Nummulitic") and oligocene periods, and which does not appear to have survived the miocene. There can, therefore, be little or no doubt that the rock fragments marked by this admixture of an older and newer (post-pliocene or recent) fauna, and comprising both marine and fresh-water types of organisms, have derived their faunal characters in great part from the deposits of a more ancient formation, which formation represents, and is the equivalent of a portion of the European "Nummulitic" (whether eocene or oligocene). The exact locality or localities which these Florida nummulitic deposits occupy *in situ* has not yet been ascertained, but it is fair to assume that the beds lie along the Gulf border (possibly in great part submerged), where, through the disintegrating action of the oceanic surf, their fragments have at a comparatively recent period been washed together with the material that at the same time was being carried out by the fresh-water streams. The

[1] The recent species *Glandina parallela, Paludina* (*Vivipara*) *Waltonii* (Tryon), and *Ampullaria depressa* have been identified by Mr. Tryon.

[2] Very rare; all the forms are referable to the type *N. planulatus* (Carpenter, *op. cit.*, p. 275; Zittel, *Handbuch der Paläontologie*, vol. 1, part 1, p. 100, 1876), of the same group (*plicatæ; radiatæ* of Carpenter) to which *N. Willcoxi* belongs.

[3] Resembling in outline the European *O. ephippium*.

precise position which the formation holds in the nummulitic scale as fixed by Hantken or La Harpe (*Étude sur les Nummulites du Comté de Nice*, Bull. de la Soc. Vaud. des Sc. Nat., vol. XVI., pp. 223–4, 1879), cannot be positively determined from our present data, since exceptionally the group of the *Nummulites plicatæ* is represented as well in the oldest as in the newest of the tertiary deposits marked by the members of this class of organisms.

FIGURES. *Nummulites Willcoxi.*
1, Natural size ; 2, Same, enlarged.

ON SUPPOSED TERTIARY AMMONITES.

BY J. S. NEWBERRY.

In the last issue of the Proceedings of the Academy of Natural Sciences (1882, Part 1, p. 94), Prof. Heilprin announces the discovery of Ammonites in rocks of tertiary age, viz.: the Tejon group of California.

Inasmuch as the verification of this statement would abrogate one of the most important distinctions between the cretaceous and tertiary fauna, I would ask Prof. Heilprin to reconsider his conclusion and review carefully the accessible facts bearing on the case. Undoubtedly the succession of living organisms on the earth has been unbroken, and somewhere there are connecting links between the faunas of all the different geological systems. A scheme of geological classification is, however, not only a convenience, but a necessity, and that at present in general use has been established by such an amount of concurrent testimony that modifications of it should only be accepted on the most undoubted evidence. The question of the age of the Tejon and Chico groups of California is not a new one. In 1855 Dr. Trask made the announcement in the first volume of the Proceedings of the California Academy of Sciences, now repeated by Prof. Heilprin, that is, the discovery of Ammonites in tertiary rocks. These he considered tertiary because they contained two fossils, pronounced by Mr. Conrad identical with his *Mactra albaria* and *Nucula divaricata*.

In my report to Lieut. Williamson in the Pac. R. Road Rept., vol. vi, Geol. p. 24, I question the accuracy of the conclusions of Dr. Trask, and the thorough investigation of the subject afterward by Mr. Gabb and Mr. Meek left no doubt whatever that the Chico Creek deposits—those in question—were of cretaceous age, as they were found to contain *Ammonites*, *Baculites Inoceramus* and other indisputable cretaceous fossils. The Tejon group in which Prof. Heilprin now records the existence of Ammonites overlies the Chico beds, and forms, according to Mr. Gabb, the summit of the California cretaceous series. But there are many species common to the Tejon and Chico groups, and where one goes the other must follow. After years of study on the spot and in the light of a greater array of facts than have been

before any other paleontologist, Mr. Gabb was decided in his reference of the Tejon group to the cretaceous system. The material which Mr. Conrad had on which to base an opinion was less abundant, but it was sufficient to satisfy him that his original classification of the rocks in question was erroneous. I would therefore ask in the interest of geological truth, that Prof. Heilprin would give to a question so important as this, very full consideration, and, if possible, make a study of the facts in the field before discarding the conclusions of Prof. Whitney, Mr. Gabb, Mr. Conrad, and Mr. Meek.

ON THE AGE OF THE TEJON ROCKS OF CALIFORNIA, AND THE OCCURRENCE OF AMMONITIC REMAINS IN TERTIARY DEPOSITS.

BY ANGELO HEILPRIN.

The controversy which for a long time was maintained between Conrad and Gabb as to the age of the Tejon rocks of California, referred by the former to the eocene series, and by the latter considered to represent the uppermost member of the cretaceous (Division B of the California Report), can scarcely be considered to have settled the question at issue.[1] Both paleontologists appear to have maintained their respective positions to the last, and to have permitted no considerations to outweigh the mass of proof that at the same time was bearing in both directions.[2] The essence of Conrad's views briefly stated is: That a portion of the rocks, that of Cañada de las Uvas, included in the cretaceous, fails "to show one cretaceous fossil," whereas, on the contrary, it is held to contain at least two representative, and at the same time highly characteric tertiary forms—"*Venericardia planicosta* and *Aturia zic-zac;*" and that, where in other deposits referred to the same horizon, an association between tertiary and cretaceous species obtains, such an association has been brought about as the result of the breaking up of the materials of an older formation, and the mixing up of their contained remains with those of a newer period. By Gabb, on the other hand, it is maintained that many of the forms referred to as tertiary species are in reality not such; that a repeated admixture between what have been considered to be strictly tertiary forms and cretaceous species manifests itself throughout the entire Californian (so-called) cretaceous series; and that no such breaking up and re-formation, as has been claimed by Conrad, are anywhere apparent.

[1] Conrad, Amer. Journ. of Conchology, I (1865), pp. 362–5; II (1866), pp. 97-100; Amer. Journ. of Science, new ser. XLIV (1867), pp. 376–7.
Gabb, Amer. Journ. of Conchology, II (1866), pp. 87–92; Amer. Journ. of Science, new ser. XLIV (1867), pp. 226-9; Proc. California Acad. Nat. Sciences, III (1867), pp. 301–6.

[2] The writer is informed by one who was intimately acquainted with both parties, that Conrad finally yielded his position, but he has been unable to discover the evidences of such a change of opinion in any of that author's writings.

The most elaborate defense of Gabb's position is that published in the "Proceedings" of the California Academy of Natural Sciences for 1867 (pp. 301–6), in a paper entitled "On the Subdivisions of the Cretaceous Formation in California." In this paper the author essays to show, by means of comparative tables, the close relation that exists between the faunal characters of the upper and lower members of his cretaceous group (Divisions B and A of the California Report), and to prove by this relationship the fallaciousness of a classification that would relegate the deposits of the group to two distinct eras in geological chronology. The following table of organic remains representing the fauna of the Tejon group (Division B), with the various localities of their occurrence, is there appended:[1]

	Upper Division (B)	Intermediate Beds.	Lower Divisions and Remarks.
Calianassa Stimpsonii,	C.T.		Chico.
Aturia Mathewsonii,	M.C.T.		Martiñez.
Nautilus Texanus,	C.		Shasta Co.
Ammonites, n. s.,	C.M.		Curry's; Benicia; Martiñez.
Typhis antiquus,	M.T.		
Fusus Martinez,	M.T.		
F. Mathewsonii,	M.C.		Curry's.
F. Diaboli,	C.		
F. aratus,	M.		
F. Californicus,	C.T.	LL.	
Hemifusus Hornii,	T.		
H. Cooperii,	C.D.		
H. Remondii,	M.C.T.G.		
? Neptunea supraplicata,	C.D.		
N. gracilis,	M.		
Perissolax brevirostris,		LL.	Many localities.
P. Blakei,	M.C.T.		
Turris Claytonensis,	C.T.		
T. raricostata,	C.		(*Varicostata* by error in Rep.)
Cordiera microptygma,	T.		
Tritonium Hornii,	C.T.		

[1] A few species occurring in beds said to be intermediate between B and A, but not properly belonging to the Tejon Group, are here included. In addition to the 107 (112, inclusive of those from the "intermediate" beds) species enumerated in the list, a small number of other forms have been described in vol. II (1869) of the "Palæontology" of the California Survey. The different localities in the above table are designated by letters, as follows: M, Martiñez; C, Clayton to Marsh's, T, vicinity of Fort Tejon; G, a locality 10 miles west of Griswold's, near New Idria: I, New Idria; D, San Diego; LL, Lower Lake Village, 1 mile southeast of the town.

	Upper Division (B).	Inter-mediate Beds.	Lower Divisions and Remarks.
T. Diegoensis,	D.		
T. paucivaricatum,	T.		
T. Whitneyi,	T.D.		
Buccinum liratum,	M.	LL.	
Nassa cretacea,	M.T.G.		
Pseudoliva lineata,	M.		
P. volutæformis,	T.		
Olivella Mathewsonii,	M.T.G.C.		
Ancillaria elongata,	C.D.		
Fasciolaria læviuscula,	C.	LL.	
F. sinuata,	T.D.		
F. Io,	T.		
Mitra cretacea,	M.		
Whitneya ficus,	T.		
Ficus mamillatus,	T.		
Natica Uvasana,	T.		
Lunatia Shumardiana,		LL.	Martiñez and elsewhere.
L. Hornii,	T.		
L. nuciformis,	C. T.(D. ?)		
Gyrodes expansa,		LL.	Almost everywhere.
Neverita secta,	T.		
N., n. s.,	G.I.		
Naticina obliqua,	M.T.		
Amauropsis alveata,	M.C.T.G.D.	LL.	Curry's; S. of Mt. Diablo.
Morio tuberculatus,	M.T.C.G.D.		
Scalaria (Opalia) Mathewsonii	M.		
Niso polita,	M. T.		
Cerithiopsis alternata,	M.C.		
Architectonica cognata,	M.C.T.		
A. Hornii,	T.		
Margaritella crenulata,	D.		
Conus Remondii,	M.C.T.D.		
C. Hornii,	T.		
C. sinuatus,	T.		
Rimella canalifera,	M.T.		
R. simplex,	C.D.		
Aporrhais angulata,	M.		
Cypræa Bayerquei,	M.C.		
Turritella Uvasana,	M.C.T.G.		
T. Saffordii,		LL.	M. and Solano Co.
T. infragranulata,	M.		
Galerus excentricus,	M.C.T.D.I.	LL.	
Spirocrypta pileum,	T.I.	LL.	
Gadus pusillus,	M.T.		
Dentalium Cooperii,	M.D.		Curry's; S.of Mt. Diablo.
D. stramineum,	M.D.		Curry's; S.of Mt. Diablo.
Bulla Hornii,	T.		
Cylichna costata,	M.C.T.D.		M.; Texas Flat and many [other localities.
Megistostoma striata,	M.		
Martesia clausa,	G.		Pence's; Texas Flat, etc.
Solen parallelus,	M.C.T.		
Solena Diegoensis,	D.		
Corbula Hornii,	T.		

	Upper Division (B).	Intermediate Beds.	Lower Divisions and Remarks.
C. parilis,	G.M.D.		
Neæra dolabræformis,	M.		
Mactra Ashburnerii,	M.C.T.		Nearly everywhere in
Gari texta,	M.		[both Divisions.
Tellina longa,	M.C.T.		
T. Remondii,	C.T.		
T. Hoffmaniana,	G.		M.; Pence's, and else-
T. Hornii,	T.		[where.
T. Californica,	C.T.		
Meretrix Uvasana,	M.C.T.I.G.		
M. Hornii,	T. [D.		
M. ovalis,	T.		
Dosinia elevata,	T.		
D. gyrata,	M.C.T.G.		
Tapes Conradiana,	G.M.T.	LL.	
T. quadrata,	M.T.		
Cardium Cooperii,	M.T.D.		
C. Brewerii,	M.C.T.G.		
Cardita Hornii,	M.C.T.I.G.		
Lucina cumulata,	T.		
L. cretacea,	C.		
Mysia polita,	M.C.I.		
Crassatella grandis,	M.T.	LL.	
C. Uvasana,	T.		
Mytilus ascia,	T.		
Modiola ornata,	M.C.T.I.		
Septifer dichotomus,	T.		
Crenella concentrica,	M.		
Avicula pellucida,	M.G.	LL.	S. Louis Gonzaga.
Arca Hornii,	T.		
Cucullæa Mathewsonii,	C.	LL.	M.
Barbatia Morsei,	D.		
Axinæa sagittata,	M.T.G.		
A. Veatchii,		LL.	M.; Tuscan Springs, etc.
Nucula (Acila) truncata,	M.T.		Everywhere.
Leda protexta,	M.C.T.G.		M.
Placunanomia inornata,	D.		
Flabellum Remondianum,	C.		

Of the total number of 112 species here enumerated, 105 are recorded as being found in Division B (Tejon group), 15 in the so-called "intermediate beds," and 21 in various deposits of the lower group (Division A). The number of forms held in common by Divisions A and B, as is shown by the above table, and the intimate faunal relations which the "intermediate beds" hold to the deposits supposed to lie above and below them, it is claimed demonstrate conclusively that the series is a continuous one, and admits of no such separation as had been insisted upon by Conrad.

The value of a comparative table, such as is here presented,

naturally depends upon the accuracy of its details; whether in the present instance this accuracy is such as to entitle the table to special consideration, remains to be seen. On page 302 of the paper last referred to Mr. Gabb states: "Of 280 species of fossils recognized and named in the Californian cretaceous rocks, 107 are found in this upper member. Of these, 84 are peculiar, *and 23 are found in common between undoubted members of this group and undoubted members of the older group.*" The inaccuracy of this last assertion will be readily manifest when an appeal is made to the data afforded by the preceding table.[1] It will be seen that here only 16 species are enumerated whose range comprises the "undoubted members" of both the older and newer groups (A and B), as follows:

Callianassa Stimpsonii,	Cylichna costata,
Aturia Mathewsonii,	Martesia clausa,
Nautilus Texanus,	Mactra Ashburnerii,
Ammonites, n. s.,	Tellina Hoffmanniana,
Fusus Mathewsonii,	Avicula pellucida,
Amauropsis alveata,	Cucullæa Mathewsonii,
Dentalium Cooperii,	Nucula (Acila) truncata,
D. stramineum,	Leda protexta.

But in glancing over the original descriptions of the species here cited, as given in vol. I of the Palæontological Report, and the more recent list of distribution published in vol. II, we find—

1. Vol. I, p. 59, that all the specimens (4) of *Nautilus Texanus* were obtained from Division A (older group), no reference being there made of its occurrence in any deposit of newer date; nor is any mention of the species being found in Division B made in the more recent list of distribution (p. 209) contained in vol. II of the Report (1869). In vol. II of the "American Journal of Conchology" (p. 88) the species is quoted from Clayton (B), but Mr. Gabb has here evidently confounded the name of a finder ("the last was found by Mr. Clayton") with that of the locality.

[1] Mr. Gabb has here evidently included the "intermediate beds" among the "undoubted members of the older group," and yet to disclaim any intention on his part for so doing, he adds (immediately following the sentence above quoted): "Besides this, I was fortunate enough to discover a locality near Clear Lake, this fall, where, within a space of two feet, I found an admixture of upper and lower forms, proving the existence of a transitionary bed, or, perhaps, group of beds." In justice to Mr. Gabb, it must be stated, that on p. 305 of the same paper, only 16 species, a figure more nearly the correct one, are stated to be common to Divisions A and B.

2. Vol. I, p. 195, no indication is given of the occurrence of *Cucullæa Mathewsonii* in deposits belonging to Division B, although the locality Martiñez, where beds representing both B and A are to be met with, is given. From this indefinite statement it might be inferred that the specimens were obtained from the upper beds, but any doubt on this point is set at rest by the subsequent reference (Amer. Journ. Conchol. II, p. 88; Cal. Pal. Rept., II, p. 249) of these Martiñez beds to the Martiñez group (A). The second locality given (for a single specimen) is "Clayton, *below*[1] the coal-veins," which in vol. II of the Report (*loc. cit.*) is referred to the "intermediate beds."

So that deducting these two forms which have not yet been detected in the deposits of Division B, these last have at the utmost (at least as far as is known), only 14 species common to the lower Division (A), instead of 23 as claimed.

But while 14 species *may* actually be held in common by the upper and lower members, we are far from satisfied that such really *is* the case. Thus Mr. Gabb states (Pal. Report, I, p. 153) that *Mactra Ashburnerii* "is one of the most common fossils in the State," and instances numerous localities of its occurrence in both divisions A and B; and further (in Am. J. Conchol., II, p. 88), that it is found in "almost every locality of both Divisions." It would certainly be a difficult matter to disprove such an affirmation, but it is, to say the least, surprising, that a careful examination of all the specimens of the Gabb collection in the possession of the Academy of Natural Sciences, which have served as the basis of the Palæontological Report, and which comprise probably the greater number, if not nearly all, of the cretaceous "types" and figured specimens, we have failed to discover a single fragment from Division A (Martiñez, Chico, and Shasta groups) that could with any amount of positiveness, or with anything more than considerable doubt, be referred to the form that under the same name is credited to Division B (Tejon group). This is the more singular since the collection embraces a very considerable number of rock fragments, which are crowded with molluscan remains. Two specimens marked in Gabb's handwriting as coming from Texas Flat (Chico group, A), and considered by that paleontologist to represent the "typical form"

[1] The italics appearing in the quotations belong to the writer of this article.

(so marked) of the species, differ very essentially in outline from the Tejon specimens, and are doubtless specifically distinct. Again, in the case of *Nucula truncata* Mr. Gabb instances (Pal. Rept., I, p. 199) several localities of its occurrence in Division A, and also Martiñez as a locality of Division B, but no mention is made of the last named as a locality of the first Division. On the other hand, *all the Martiñez specimens of this species in the Gabb collection are marked as belonging to Division A!* In vol. II (p. 197) of the Reports, however, we are informed that this species is "found at almost every locality of the Chico, Martiñez, and Tajon groups," but we must confess that, after a diligent search, we have failed to discover among the Tejon rock fragments anything that could with sufficient evidence be referred to this form. Nor have we been able to find the faintest traces of *Leda Gabbii* (*protexta* of Gabb) (or for that matter, of several other forms belonging to group B) in the rock fragments obtained from the older members, but it would perhaps be premature to conclude from this that it may not really occur there. On page 199 of vol. I, the only locality given for Division A is (near) Martiñez (at the same time a locality for Division B), but in the "tabular statement" appended to the same volume (p. 235) the ranch of San Luis Gonzaga is substituted instead. *Tellina Hoffmanniana* is not stated in the original description (vol. I, p. 156) to be found in any locality of Division B, nor is it included in the list of "common" species given in 1866 in the American Journal of Conchology (11, p. 88). In vol. II of the Reports, however (p. 182), this species, which could originally "always be distinguished by its straight or slightly convex cardinal margins," but which has now become a "rather variable" form, is reported from two localities (Martiñez and "Griswold's") of the Tejon group. An inspection of Mr. Gabb's figures (I, pl. 22, figs. 33, 33a; II, pl. 30, fig. 72) will, we believe, fail to convince one that in both instances the same species is represented, and, indeed, in the Martiñez (B) specimens the "straight or slightly convex cardinal margins" characteristic of the species have become both anteriorly and posteriorly *decidedly* convex.

Mr. Gabb invokes the assistance of his "intermediate beds," unknown to him at the time of the publication of the first volume of his Reports, to prove the intimate relation that exists between the upper and lower members of his cretaceous series. An ex-

amination of the preceding table will show that 7 species, not found in deposits older than the intermediate beds, are credited as being common to these last and the Tejon group, as follows :—

Fusus Californicus,	Spirocrypta pileum,
Buccinum liratum,	Tapes Conradiana,
Fasciolaria læviuscula,	Crassatella grandis.
Galerus excentricus,	

These are said to be associated with a limited number of forms that are found in the lower division, but which do not pass above, and (if we except *Cucullæa Mathewsonii*, which has been shown *not* to belong to the upper member) with only one *solitary* form, *Avicula pellucida*, that is common to both divisions, a circumstance of suspicious import. But in turning to the original description of *Fasciolaria læviuscula* (vol. I, p. 101) we find no mention of its being found in deposits belonging to Division B, but on the contrary, it is distinctly stated to have been "found in the strata immediately *below* the coal in the Mount Diablo district" (although it was *associated* with several species found also at San Diego and Martiñez of Division B), and in vol. II of the Report (p. 220), *only* the "beds intermediate between the Martinez and Tejon groups" are given as the locality of its occurrence. Nor do we find in the lists of distribution contained in vol. II[1] any mention of the "intermediate beds" in the case either of *Buccinum (Brachysphingus) liratum*, *Galerus excentricus*, or *Spirocrypta pileum*, although it does occur in the case of the remaining three (*Fusus Californicus*, *Tapes Conradiana*, and *Crassatella grandis*).

We believe it may be fairly questioned, from what has already been shown, whether Mr. Gabb's tables afford *at all* a safe criterion upon which to base the solution of the problem at issue. The numerous discrepancies would seem to prove almost conclusively that in their preparation the author was in a measure, or even to considerable part, borrowing from his memory, or, at any rate, not absolutely from the data that were presented in the field. But granting that the tables be entirely trustworthy in the statements that have been called into account, do they at all prove his case?

[1] Published more than one year *after* the paper in the "Proceedings of the California Academy, and therefore at a time when Mr. Gabb ought to have been fully cognizant of the value and position of his intermediate beds.

We believe most assuredly not. Surely a geologist would find it difficult, on the assumption of immediate continuity and without the assistance of a change in the general character (whether marine, fluviatile, or terrestrial) of the fauna, to account for the rather anomalous circumstance, that, in a locality rich in organic remains, the upper member of a closely connected series should be characterized by a fauna about 80 per cent.[1] of whose individual forms is peculiar to itself. In order to antagonize this difficulty, and, at the same time, to show still more effectively how much more closely the members of this upper group of deposits are linked to the beds below them (and, consequently, how indisputably cretaceous) than to those following (and, therefore, how little tertiary), Mr. Gabb submits the argument (Proc. Cal. Acad. Nat. Sciences, 1867, p. 306; A. J. Science, new ser., vol. XLIV, p. 229), that "All of the species are peculiar to this group (B), or to this and *underlying*[2] rocks; *not one* has been found associated either with living forms, or with species known to occur in the recognized tertiaries of California. Five of the genera are peculiar to the secondary. An Ammonite ranges entirely through the group to the top of the highest fossiliferous strata. The genera *Perissolax*, *Gyrodes*, *Margaritella*, and the sub-genus *Anchura*, of the genus *Aporrhais*, are all recognized as strictly characteristic of the cretaceous; so much so, that the presence of a single undoubted representative of either of these genera would be strong presumptive evidence of the cretaceous age of any rocks in which it might be found." But Mr. Gabb omits to emphasize in this connection (although a casual reference to a part of the facts is made), and as directly bearing upon the subject of chronological relationship, the *first* appearance (in California) in the deposits of this group of the genera (among others) *Ancillaria*, *Bulla*, *Conus*, *Cypræa*, *Crepidula* (*Spirocrypta*), *Cassidaria* (*Morio*), *Ficus*, *Gadus*, *Mitra*, *Nassa*, *Niso*, *Olivella* (*or Oliva*), *Pseudoliva*, *Rimella*, *Triton*, *Trochita*, *and Typhis*, many of them distinctively, and as has been generally recognized *exclusively* tertiary forms. Nor does that paleontologist appear to lay the least stress upon, or even advert to the circumstance that the eminently mesozoic genera *Ancyloceras*, *Hamites*, *Helicoceras*,

[1] The percentage takes into account the full number of forms said to be held in common by the upper member and the intermediate beds.

[2] The italics are Gabb's.

Turrilites, *Crioceras*, ?*Ptychoceras* (*Helicancylus*), *Baculites*, *Inoceramus*, *Trigonia*, *Gryphæa*, and *Exogyra*, which are found in one or other, or several of the deposits of the older group (A), are here completely wanting. Surely the wholesale appearance and disappearance of characteristic genera have *at least* as much import in the determination of geological chronology, or in the fixing of systemic relationships, as the casual persistence of a few specific types, and, indeed, a paleontologist or zoologist would be very bold to assert that the distinctive characters of a fauna depend rather upon the features drawn from its specific, than from its generic constituents.[1] It would appear strange, to say the least, if a geologist were now to unite the Devonian and carboniferous formations, or the Silurian and Devonian, for no other reason than that they comprise in their several faunas a number of "common" forms, when the general facies of these faunas is very distinct.[2]

[1] Accepting the generic determinations of Mr. Gabb, we find that of about 77 genera credited as belonging to the Tejon group, no less than 33 (or 43 per cent.) have *not* been described from the cretaceous deposits underlying this group; and 3 additional ones do not pass beyond the "intermediate beds!" The faunas are here, then, decidedly *very* distinct, despite the fact that a limited number of "common" or passage forms (forming at the utmost only about 13 per cent. of the Tejon fauna) may be said to exist.

[2] According to Etheridge (Anniversary Address, London Geol. Soc., 1881—Quart. Journ. Geol. Soc., pp. 184–185), of 37 species of brachiopods occurring in the upper British Devonian, 16 pass into the succeeding carboniferous deposits; these last also hold 5 species of upper Devonian lamellibranchs, 5 gasteropods, 2 heteropods, and 4 species of the genus *Orthoceras*. Of the total number of 183 genera and 526 species constituting the British Devonian fauna, 30 genera and 49 species pass into the carboniferous (*loc. cit.*, p. 197). In California, of about 141 genera described from Division A (Martiñez, Chico, and Shasta groups), 44 are also found in Division B (Tejon group), and, therefore, the proportion of generic forms common to what is here claimed to be both cretaceous and tertiary is greater than that which obtains in the case of the British Devonian and carboniferous formations. But if in both instances only the molluscan fauna (which comprises, with the exception of 5 species, all of Gabb's described forms) is taken into account, a very striking correspondence in the numerical proportions presents itself. Thus, according to Etheridge's tables, 25 out of the 74 Devonian molluscan genera appear in the carboniferous deposits, or nearly 34 per cent.; in California, 40 of the 133 Division A genera are also represented in Division B, or 30 per cent. According to

But it is here maintained, that in addition to a purely specific relationship we have one established through generic ties. "An Ammonite ranges entirely through the group to the top of the highest fossiliferous strata. The genera *Perissolax*, *Gyrodes*, *Margaritella*, and the sub-genus *Anchura*, of the genus *Aporrhais*, are all recognized as strictly characteristic of the cretaceous; so much so, that the presence of a single undoubted representative of either of these genera would be strong presumptive evidence of the cretaceous age of any rocks in which it might be found" (Proc. Cal. Acad., p. 306). Laying aside for the present the question of the Ammonite, only a few words need be said respecting the other genera.[1] As Mr. Conrad has already shown (A. J. Science, new ser., xliv, p. 376), no locality in Division B is assigned to the (2) species of *Gyrodes* in vol. i, of the report, but on the contrary, both are clearly assigned to the Division A; and

Mr. Etheridge (*loc. cit.*, p. 179), 12 genera (of 187), and 20 species (of 392), of Ludlow (upper Silurian) fossils pass into the Devonian; and 11 genera (of 61), and 16 species (of 182) from the Cambrian into the Silurian (Arenig) (p. 100).—The circumstance that the faunal break between the cretaceous and tertiary periods is in all, or nearly all, localities thus far studied greater than between the Devonian and carboniferous or the Silurian and Devonian, has no bearing on the point at issue, since a connection or passage must exist somewhere, and it is quite immaterial where this passage may be found. The assertion that has at various times been repeated that no cretaceous species have been known to pass beyond the limits of that period, has been definitely refuted by comparisons made between the foraminiferal faunas of chalk and the Atlantic ooze, and, doubtless, impartial examination will reveal a number of higher forms in post-cretaceous deposits, undistinguishable from forms which have up till now been considered to characterize strata of more ancient date. It would probably puzzle many paleontologists to determine by what special characters certain cephalopods (*Nautilus*) or brachiopods of tertiary, or for that matter, of recent age, are distinguished from their more ancient congeners, and, indeed, even such a high authority as Mr. Davidson ("British Tertiary Brachiopoda," p. 14, Palæont. Soc. Repts.. 1852), has found it difficult to differ from the opinion expressed by Edward Forbes that at least one existing brachiopod (*Terebratulina caput serpentis*) is also a cretaceous form.

[1] Although in the text it is not *absolutely* stated that these several genera all occur in the rocks of the Tejon group (but "in this and associated rocks"), the connection in which the statement is made would seem to imply that they did so occur; and Mr. Gabb's inference would certainly justify such an interpretation of the statement.

in vol. ii (p. 222) the transition beds are given as the upper limit of the genus. In the case of the genus (or sub-genus) *Anchura*, the species especially referred to, *A.* (*Aporrhais*) *angulata*, is stated (vol. i, p. 128) to occur very sparingly near Martiñez "in a single stratum of greenish-gray limestone," and is credited *exclusively* to Division B; yet, in the same description, a locality in Division A—Cottonwood Creek, Shasta County—is mentioned! Furthermore, in the "tabular statement" appended to the same volume (p. 227), the Martiñez locality of the identical species is referred to Division A! In vol. ii (p. 226), while the localities are given, the group has been wisely omitted. As to the forms that have been referred to *Perissolax*, it would be very difficult to state why they should be considered as being characteristically cretaceous. It is true that the genus was founded on cretaceous species,[1] but it would be, indeed, a very comprehensive genus that would embrace such entirely dissimilar forms as the *Pyrula* (*Fusus*) *longirostra* of D'Orbigny,[2] one of the types of the genus, and the *P. Blakei* (*Busycon? Blakei* of Conrad) and *P. brevirostris* that are here referred to it (and also the *Fusus Durvillei* and *F. Hombroniana!*).[3] There is, as far as we are aware, not the faintest reason for considering the California species here indicated as representing cretaceous molluscan types, whatever may be thought of the genus *Perissolax* as originally founded; on the contrary, as Conrad has pointed out (A. J. Science, new ser., xliv, p. 376), they more properly belong to his genus *Levifusus* (subgenus? of *Fusus*), represented in the eocene of Alabama by the *Fusus trabeatus* (*F. bicarinatus* of Lea, young).

Respecting the forms that have been referred to *Margaritella*, and to their being "strictly characteristic of the cretaceous," it need only be stated that Mr. Meek, the author of the aforesaid

[1] Gabb, Proc. Am. Philos. Soc., 1861, p. 66.

[2] *Paléont. de l'Amér. mér.*, p. 119, pl. 12, fig. 13.

[3] D'Orbigny, *Voyage de l'Astrolabe et de la Zélée*, pl. 2, fig. 1, and pl. 1, fig. 31. . . . Gabb, Proc. Amer. Philos. Soc., 1861, p. 67. It can scarcely be wondered at that neither Conrad nor Stoliczka could grasp the characters of the genus, and that the latter referred the typical form not only to a distinct genus, but to a very different family, the *Purpuridæ* (Palæontologia Indica, Cretaceous Fauna, II, p. 149).

genus, distinctly affirms[1] that they do *not* belong where they have been placed, but in the genus *Solariella* of Wood, which was founded on a tertiary (pliocene) fossil, *S.* (*Margarita?*) *maculata* from the British Coralline Crag.[2]

So far, therefore, not one of Gabb's characteristic cretaceous genera, with the exception of the Ammonite, of which several specimens are said to have been found in the rocks of the Tejon group (and of which, or of an allied genus of the *Ammonitidæ*,[3] the author of this article was fortunate enough to discover a solitary fragment), carries out the inference that has been drawn from their actual or supposed existence.

Having thus, as we believe, satisfactorily shown the erroneousness of many or most of the data that have served as a guide in the classification of the rocks in question, and to their reference to the cretaceous period, it now remains to examine in greater detail the reasons why these should be considered as *not* cretaceous, but tertiary. Briefly repeating what has already been said, we find that the Tejon fauna (considered solely with respect to the other California faunas) comprises about (and *probably considerably more than*) 80 per cent. of forms peculiar to itself, or at least that are not found in deposits representing a lower horizon; that 33 out of its 77 genera, constituting 43 per cent. of the entire number, are likewise not represented in the older deposits; that with the exception of a few fragments or specimens (about 7 in all) of one or two forms of *Ammonitidæ*, there is a complete absence of distinctively cretaceous organic types (while they are sufficiently plentiful in the subjacent beds); and finally, that there is a sudden introduction of new molluscan types, most of which are but barely, if at all represented in the cretaceous deposits of the world (as far as has yet been determined), and several of which are not known to have preceded the tertiary period. The appearance here for the first time of the genera *Ancillaria*, *Bulla*, *Conus*, *Crepidula*, *Cassidaria*, *Cypræa*, *Ficus*, *Gadus*, *Mitra*, *Nassa*, *Niso*, *Olivella* (or *Oliva*), *Pseudoliva*, *Rimella*, *Triton*, *Trochita*.

[1] U. S. Geol. Survey of the Territories, ix, Invertebrate Palæontology, pp. 301-2, 1876.

[2] Catalogue of Crag Mollusca, Ann. Mag. Nat. Hist., ix, 1842, p. 531; "British Crag Mollusca" (Palaeont. Soc. Rep., 1848), i, p. 134.

[3] The fragment was too imperfect to admit of positive generic determination.

and *Typhis*[1] has already been adverted to. But these are not the

[1] The writer is unaware that any unequivocal species of the genera *Ficus* (*Sycotypus; Pyrula*, as restricted), *Gadus*, *Nassa*, *Niso*, *Olivella* (or *Oliva*), *Rimella*, or *Typhis*, have been described from deposits antedating the tertiary.

Pyrula Pondicherriensis of Forbes (Trans. Lond. Geol. Soc., vii, p. 127, 1846; *Pyrula Carolina* of D'Orbigny, Voy. Astrolabe et Zélée, Pal. pl. 11, figs. 34 and 35), a ficuliform species from the cretaceous deposits of India, has been shown by Stoliczka to belong to the *Volutidæ*, and to a new genus, *Ficulopsis* (Pal. Indica, Cretac. Fauna, ii, pp. 84–5).

Nassa lineata of Sowerby (Fitton's Report, Trans. Lond. Geol. Soc., 2d ser., iv, p. 344, pl. xviii, p. 25), from the Blackdown sands, may be a true member of the genus to which it is referred, but neither the figure nor description of the species permits of such a determination. The second species described in the same report, *N. costellata*, has been referred by D'Orbigny, Pictet, and Stoliczka to *Cerithium*. The first of these is the only cretaceous species recognized by Pictet and Campiche (*Materiaux p. l. Paléont. Suisse*, iii ser., p. 673) as being probably a *Nassa*, but the author's conclusions on this point appear to have been based entirely upon Sowerby's original determination. Stoliczka (*op. cit.*, p. 143) places *Buccinum Steiningeri* of Müller (*Petr. Aach. Kreidef.*, p. 78, 1851), an unfigured species from the chalk of Aix-la-Chapelle, in *Nassa*, but on what authority or for what reasons, this reference is made, we have found it impossible to discover. The two species of *Nassa* described by the last named author from the cretaceous Arrialoor group of India, *N. Vylapaudensis* and *N. Arrialoorensis*, and determined from imperfect specimens, are at best but very doubtful, and, indeed, it is stated that the last may possibly be a *Mangelia* or *Defrancia* (*op. cit.*, p. 145)!

Niso Nerea of Deslongchamps (*Bull. Soc. Linn. Norm.*, 1860, v. p. 126; *Turbo Nerea* of D'Orbigny, *Pal. Franc. Terr. Jur.*, pl. CCCXXVI, figs. 4 and 5) considered by Stoliczka (op. cit., p. 288) to be possibly referable to one of the subgenera of *Niso*, does not appear to have much, if anything, in common with that genus; nor can much more be said in favor of the other species (*Turbo*, *Trochus*, etc.) referred by Deslongchamps to the same genus.

Oliva vetusta of Forbes (Trans. Lond. Geol. Soc., 2d ser., VII, p. 134, pl. 12, fig. 23), from the cretaceous rocks of Southern India, is a *Dipsacus* according to Stoliczka (Pal. Indica, Cret. Fauna, II, p. 452, pl. XXVIII, fig. 27). The *Oliva? prisca* of Binkhorst (*Monogr. Gastr. et Ceph. Craie sup. de Limbourg*, 1861, p. 71, pl. Va^2, fig. 14) is unrecognizable as a member of the genus to which it is referred, and, according to the author himself, may possibly be a fragment of a *Cypræa*.

Of the genera *Pseudoliva* and *Ancillaria* it would appear that only a single cretaceous species of each has thus far been recognized; the *P. subcostata* of Stoliczka (*op. cit.*, p. 145) (from the Arrialoor group of Southern India), described from a solitary imperfect specimen, and the *A.*

only more or less strictly tertiary genera that are here represented. In the *Tritonium paucivaricatum* (Palæont. Calif., I, p. 95, figs. 209, 209a, very badly figured) we have a true *Cancellaria!* The *Megistostoma* (new genus[1]) *striata* (I, p. 144) is a true *Bullæa*, a genus represented by a very limited number of fossil forms, and so far not known to have appeared before the tertiary period. *Naticina obliqua* (I, p. 109) appears more like a *Sigaretus*, the shell (in the specimens examined, all of which are partially imbedded in the matrix) being considerably more depressed than in the genus *Naticina*. But to whichever of these two genera the species may belong, it is immaterial in the present consideration, since no unequivocal member of either form, as far as the writer is aware, has been described from any formation older than the tertiary.[2] In vol. II of the Report (p. 157) we have described a member of the genus *Bullia* (sub-genus *Molopo-*

cretacea of Müller (*Monogr. Petr. Aach. Kreidef.*, p. 79, pl. 6, fig. 23), from the chalk of Aix-la-Chapelle, and described from a single imperfect impression. The least equivocal of the several doubtful cretaceous forms that have been referred to the genus *Conus* is probably the *C. Marticensis* of Matheron (*Cat. des Corps organisés fossiles, Bouches-du-Rhone*, 1842, p. 257. pl. 40, figs. 24–25), from the chalk of Martigues. There seems to be no reason for specially doubting that the imperfect specimen here figured is a true cone, but yet it would be by no means surprising if closer examination would prove it to be a form more closely related to *Acteonella* or *Acteonina*. The *C. tuberculatus* of Dujardin (*Mém. Soc. Geól. de France*, 1835, II, p. 232, pl. XVII, fig. 11), from the chalk of Tours, is not unlikely, according to Stoliczka (*op. sit.*, p. 72), to be a member of the cretaceous genus *Gosavia*, which it resembles (differing from all other true cones) in its ornamentation. *Conus canalis* of Conrad (Journ. Phila. Acad. Nat. Sciences, 2d ser., III, p. 321, pl. 35, fig. 22), from the "Ripley" group of Mississippi, scarcely admits of positive generic determination. *Conus gyratus* of Morton, (Syn. Org. Remains, Cretac. group, 1834, p. 49, pl. X, fig. 13), from the white limestone of South Carolina, is an eocene species.

[1] The distinctive characters of this supposed new genus, as pointed out by Gabb, are more imaginary than real.

[2] *Natica acutimargo* of Rœmer (*Verstein. Nordd. Kreidegeb.*, 1841, p. 83, pl. XII, figs. 14, a, b), from the chalk marl of Quedlinburg and Dülmen, and said to have fine revolving lines, may possibly prove to be a *Sigaretus*, but the sutural canaliculation would seem to render this point rather suspicious. *Sigaretus Pidanceti* of Coquand (*Mém. de la Soc. d'émul. du Doubs*, 2me sér., VII, p. 46, pl. 5, figs. 4 and 5, 1856) is a *Natica* according to Pictet and Campiche (*Mat. Paléont, Suisse*, 3me sér., p. 330, pl. LXXVI, fig. 1, a, b, c.)

phorus, doubtfully different from the tertiary and recent genus, or sub-genus, *Buccinanops*); and finally (*Ibid.*, p. 162), a *Terebra* (*T. Californica*), a genus whose range has not yet positively been determined to extend back beyond the limits of the Tertiary period.

So that of the 77 genera represented in the Tejon group, at the very least 22 are more or less distinctively[1] tertiary; and of these 22, 11 are not positively known to have appeared before that epoch of geological time. On the other hand, if we except the six or seven fragments of *Ammonitidæ* (one, or possibly two genera) already referred to, there would seem to be in the entire number *not a single distinctively cretaceous generic type!*

EVIDENCE AFFORDED BY SPECIFIC FORMS.

The circumstance, considering the deposits here referred to to be eocene, that "not one [species] has been found associated either with living forms, or with species known to occur in the recognized tertiaries [miocene and pliocene] of California" (Gabb, Proc. Calif. Acad. Nat. Sciences, 1867, p. 306), is not very surprising. The number of species that pass from the deposits of eocene age into the miocene is frequently very limited, or there may not be a single one. This last is, singularly enough, what obtains in the case of the tertiaries of the eastern and southern United Stated, where both the eocene and miocene formations are extensively developed, and where the organic remains are also very abundant.[2]

Leaving aside the question of identity as existing between the eocene and miocene forms, it will be important to ascertain what correspondence, if any, manifests itself between the specific types of the deposits here discussed, and those of other tertiary (eocene) localities; for the determination of this point we subjoin the following notes on a few of the species:

Cardita Hornii and Cardita planicosta.—Whether the species of *Cardita* described by Conrad from the rock of Cañada de las Uvas as *C. planicosta* (Pacific R. R. Reports, V, p. 321), and designated by him as the "finger post of the eocene" (*Ibid.*, p. 318), is the veritable *C. planicosta* of Lamarck, or not, it is impossible to state. The author's intimate acquaintance with that species, from both European and American

[1] But sparsely, if at all, indicated in the earlier deposits.

[2] It would be, perhaps, going too far to state, that not a single species is held in common by these eocene and miocene deposits; it would be more proper to say, that none such has yet been recognized.

forms, ought certainly to have enabled him, in the presence of fairly preserved specimens, to determine this point definitely, but whether the specimens in question were actually in a condition to admit of such positive determination, can, at the present time, only be conjectured. The description accords well with the species (and in a measure, also, the figure), but it is a little too brief to admit of a positive conclusion being drawn therefrom. For a similar reason it would be impossible to affirm conclusively whether the species is, or is not the *C. Hornii* of Gabb (Palæont. Calif., I, p. 174; II, p. 188), specimens of which were found near the same locality. I believe there can be no doubt that the character pointed out by Gabb (II, p. 188), as distinguishing the two species here mentioned—namely, the form of the ribs, which are rounded in the one (*C. Hornii*), and flattened in the other (*C. planicosta*)—has a certain value, but whether sufficient to permit of specific distinctions being based upon it in the absence of all other characters, can only be determined when a greater number of perfect specimens will have been brought together for comparison. In all other respects the two species appear to be identical, as will be seen from the following (Gabb's) statement: "I have compared my specimens with shells from the London clay, and from the Alabama eocene, and find that, except in the extreme quadrate forms,[1] they are absolutely identical in all characters save one. The hinges are so similar that I despair of making an intelligible written description of their minute differences, and should hardly feel willing to trust an artist with their delineation." Granting the specific value of the character claimed by the aforesaid paleontologist, the type (*C. Hornii*) still remains distinctively tertiary,[2] since what may be considered as analogous forms, are to the knowledge of the writer, completely wanting (although the genus is already represented) in the pre-tertiary deposits.

Dosinia elevata (I, p. 167) is more likely, as stated by Conrad, to be a *Dosiniopsis* than *Dosinia* (Am. J. Conchol., II, p. 98), despite the assurances of Mr. Gabb to the contrary (*Ibid.*, p. 91).[3] As much as can be determined from the figured specimen it appears to be very closely allied to the *Dosiniopsis Meekii* of Conrad (*Cytherea lenticularis?* of Rogers), from the lower eocene of Maryland and Virginia, from which it mainly (or barely) differs in the greater width of the flattened area on the posterior slope.

Meretrix Hornii (I, p. 64; II, pl. 30, fig. 78), a form allied to, but not as produced posteriorly as the *Cytherea suberycinoides* of the Paris basins.

Ficopsis (Hemifusus) Rémondii (I, p. 87, pl. 18, fig. 36), a form very closely related to, if not identical with the *Pyrula penita* of Conrad (= *P. nexilis* and *P. tricarinata* of Lamarck), from the eocene of Claiborne, Ala. The occasional tricarination observable in that form, as well as in its European representative, is here also apparent. The only difference of any account we could detect between the two species is that in the Californian form the surface reticulation is somewhat the finer, but since there is no exact constancy in the order of this reticulation, it may be doubted whether the difference here noted is of more than varietal value.

[1] . . . though some specimens, four and four and a half inches across, are as distinctly triangular as the typical *planicosta*" (II, p. 188).

[2] The character of the ribs, previous to weathering, is very much as in the *C. pectuncularis* or the *C. Jouanneti.*

[3] No perfect hinge is exhibited in any of the specimens of the Gabb collection, which includes the figured form.

Tritonium paucivaricatum (I, p. 95, pl. 28, figs. 209, 209a, unrecognizably figured), as has already been stated, is a *Cancellaria*, and a form so closely related to the *C. evulsa*[1] of Brander ("Fossilia Hantoniensia," 1766, p. 14, as *Buccinum*; pl. 1, fig. 14), from the British Bartonian (upper eocene), that it may well be doubted whether it is at all specifically distinct; and the same may be said of its relation to a form[2] from the lower eocene deposits of Clarke County, Ala., which is doubtfully referable to the *C. tortiplica* of Conrad.

Megistostoma striata (I. p. 144, pl. 21, figs. 108a, b).—While, perhaps, from the slightly imperfect condition of the specimen, it would be impossible to affirm positively that this species is identical with the *Bullæa expansa* of Dixon, from the eocene of Brackelsham, England, and the Paris basin (Deshayes, *Animaux sans Vertebres, Bassin de Paris*, II, p. 652, pl. 36, figs. 27–30, *Mollusques Cephales*), yet, what there is of it shows absolutely no character by which to distinguish it from that species.

CONCLUSION.

We believe it has been satisfactorily shown from what has preceded, that the rocks of the Tejon group (cretaceous Div. B. of the California survey), despite their comprising in their contained faunas a limited number of forms[3] from the subjacent

[1] Compared with actual specimens.

[2] Kindly transmitted for examination, with other fossils, by Dr. Eugene A. Smith, State Geologist of Alabama.

[3] The reliance that is to be placed upon Gabb's *positive* assertions as to the localities or horizons whence certain species have been obtained, may be inferred from the statement (Am. Journ. Conchology, 1866, II, p. 90), that *Naticina obliqua* and *Turritella Uvasana*, species claimed to be eocene by Conrad, were "found by Mr. Rémond and myself in strata containing *Ammonites* and *Baculites*, and abounding in other cretaceous forms." A reference to the descriptions of these two species, as well as to the various tables of distribution published (before and after the making of the statement) by Gabb, clearly shows that the forms in question were *not* known to that paleontologist to pass beyond the limits of Division B. How then could they be associated with the *Baculites*, when the only Californian species of that genus, *B. Chicoensis*, is distinctly stated (I, p. 81) to be "only found in Div. A"? So likewise from the statement (Am. Journ. Conchology, II, p. 89), that *? Ammonites Cooperii*," one of the *Ammonitidæ*, whether an *Ammonite* or not, is from the presumed eocene of Mr. Conrad, from San Diego, and the family is sufficient to establish the age of that deposit, had we no other proof." But singularly enough, in the description of this ammonitic fragment (I, p. 70), the specimen is said to be "of particular interest from the fact that it is *one of the oldest* fossils found in the southern part of the State, being *considerably below* the newer cretaceous fossils of San Diego!" (The italics belong to the writer of this article). And in vol. II (p. 212) the species is doubtfully referred to the Chico group!

(cretaceous) deposits, and a few undoubted representatives of the *Ammonitidæ*, are of tertiary (eocene) age, and for the following reasons:

I. The large percentage (about 80, or possibly considerable more) of specific forms that are peculiar to the group, or, at least are not found in the older deposits;

II. The large proportion of generic forms (33 out of 77) that are not represented in the underlying or older strata;

III. The presence of 22 more or less distinctively tertiary genera: *Ancillaria*, *Bulla*, *Bullæa* (*Megistostoma*), *Bullia* (s. g. *Molopophorus*) *Conus*, *Crepidula*, *Cassidaria*, *Cancellaria*, *Cypræa*, *Ficus* (*Ficopsis*), *Gadus*, *Mitra*, *Nassa*, *Niso*, *Olivella* (or *Oliva*), *Pseudoliva*, *Rimella*, *Sigaretus* (or *Naticina*), *Terebra*, *Triton*, *Trochita*, and *Typhis;*

IV. The marked absence (with the exception of about a half-a-dozen fragments or specimens of *Ammonitidæ*) of distinctively cretaceous organic types;

V. The identity, or very close analogy existing between several of the specific forms and their representatives from other well determined tertiary (eocene) deposits.[1]

[1] The eocene age of the Tejon rocks is maintained by Prof. Jules Marcou (Report of the Chief of Engineers, Washington, 1876, p. 387), who made a personal examination of the region. "I was not able to find a single cretaceous fossil, nor even any true cretaceous generic forms, in the entire formation; and I am altogether of the opinion expressed by Mr. Conrad, many years before Mr. Gabb, in volume 5, of Pacific Railroad Explorations, pages 318, 320, *et. seq.*, who, judging from certain fossils found in an isolated block, at the entrance of the Cañada de las Uvas, has very judiciously referred these rocks to the eocene-tertiary formation" . . . . "The fauna of Tejon reminds one very much of the fauna of the sands of Anvers [?], near Pontoise, and of the sands of Gre[*i*, ?]gnon, near Versailles."

JULY 11, 1882.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Thirteen persons present.

A paper was received for publication, through the Botanical Section of the Academy, entitled "On Rhus cotinoides," by Dr. Chas. Mohr.

JULY 18, 1882.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Nine persons present.

Nest of Chætura pelasgia.—Mr. THOMAS MEEHAN exhibited a nest of the chimney-swallow, or swift, from a chimney in Germantown. It was made of small twigs of the cherry-tree, and fastened together, and to the wall of the chimney by vegetable gum of some kind, indeed, pure gum, undistinguishable in taste and general appearance from the kind which exudes from cherry-trees. He referred to the statement of Audubon, and which has apparently been copied without further question by subsequent authors, that the gum used by the bird in the building of its nest is a salivaceous secretion of its own, and that there are within the mouth of the bird, special organs provided for this secretion. Only for this positive statement of Audubon there would be no question, he thought, that this was cherry-gum, obtained at the same time and place from where the twigs were obtained, namely, the cherry-tree. It was not easy to tell one kind of gum from another in the absence of chemical analysis, but he believed there was no difficulty in distinguishing animal gum from the gum yielded by vegetables. It was inconceivable that an animal should secrete vegetable gum. Still, in view of Audubon's statement, the question was one for anatomists to settle.

It was, he said, worthy of remark that other species of swallow used vegetable gum for nest making. A cave-swallow of Cochin China used a gelatinous seaweed, a species of *Gelidium* not far removed from *Chondrus crispus*, the well-known Irish moss, to make their nests. This formed the so-called edible nests of China. Lamaroux, as quoted by Dr. Peyre Porcher, in his "Medical Properties of Cryptogamous Plants," remarks that far inland the birds employed other material to build their nests, but secured some of the *Gelidium* which they employed to stick the materials together, and fasten the nest to its support. The collecting of vegetable gum for this purpose is expressly conceded in the case of this species.

In regard to the nest exhibited, Mr. Meehan called attention to the fact that the gum with which the twigs were coated, had evidently all been deposited on the wall before the collection of the twigs; and, as the twigs were placed, the gum was softened perhaps by saliva, or perhaps by water brought in the bird's bill, so that it could be drawn over the twigs. This was evident by the lines of gummy threads, which mostly started from the mass on the wall, and decreased in thickness as they were drawn out, terminating in filmy lines. He called attention to the nest exhibited as being obliquely built, and not set regularly against the face of the wall. That this appeared to be intentional seemed evident from the fact that the finer ends of the twigs all started from right to left and which, after being fastened there by the gum, were bent around to the left, making a greater curve at the right, on account of the less resistance from the slender end of the twigs. This obliquity seemed a great advantage to the bird, as it provides for sitting nearly parallel with the wall. If the bird sat at right angles with the wall, its long wings would be very much in the way of her work.

Miss Grace Anna Lewis remarked that she had once had an opportunity of seeing a chimney-bird at work repairing the nest upon which it was sitting. The bird adjusted a loose stick with ease, and then plastered it with its bill, using the latter in the manner of a trowel. It then waited quietly, apparently to give time for a further secretion, and worked and rested alternately, until the damage was repaired. All this was distinctly seen through a pipe hole opposite the nest of the bird.

Miss Lewis had seen many nests of the chimney-bird and did not think they were usually larger on one side than the other, but supposed that the specimen shown by Mr. Meehan, had been warped by rain, and redrying.

When first built, the nests are quite symmetrical, and in the form of a quarter of a globe. The particular nest to which she referred had been built by placing two sticks vertically, and attaching the cross-pieces to these, to form the open basket-work. She thought the cement used to fasten the sticks was of animal origin and was derived from the bird itself. When fresh and unsmoked, the cement does not resemble even in color, the gum of the cherry-tree.

July 25, 1882.

Mr. Thos. Meehan, Vice-President, in the chair.

Eight persons present.

Dr. Maxwell T. Masters, of London, was elected a correspondent.

The following was ordered to be printed:—

RHUS COTINOIDES, NUTT.

BY CHARLES MOHR.

Since its discovery by Nuttall, in the year 1819, in Arkansas, and twenty-three years later by Prof. Buckley, in North Alabama, this tree has not been found by any other botanist, and our knowledge of it remained fragmentary and obscure.

After having been lost to the botanical world for fully forty years, its re-discovery and observation in the various stages of its growth was deemed of sufficient interest to be made a special object in my investigation of the forest growth of the Gulf region for the Tenth Census. To this end, several trips were made to the southern declivity of the Cumberland Mountains as they descend upon the valley of the Tennessee River in Madison County, Ala. On the 21st of September, a successful search for the Baily farm was made, where, in the mountains near by, Prof. Buckley found the tree in the beginning of April, 1841.[1] This place is situated near the base of a bold mountain range rising to a height of 900–1000 feet above the Tennessee River.

The sight of my botanizing capsule dimly recalled to the present owner, the Professor's visit at his father's, but he had no conception of its object. He informed me that there is a small tree found in abundance in the low foothills skirting the valley, yielding a yellow wood used for dyeing, which he considered to be the tree I was in search of; and as fine specimens could be obtained nearer by, the trouble of hauling them down the mountain could be avoided.

Great was my disappointment when the *Rhamnus Carolinianus* was pointed out to me as the yellow wood. I felt quite relieved by the forthcoming statement that there was another kind of the yellow wood found on the rocky benches near the summit of the mountain, of which his father brought down a stick over 30 years ago, to serve, on account of its strength and durability, as a cross-piece to the rack used in his slaughter-pen. On a closer examination it was found to be a kind of timber I had never seen before, and after an exposure for such a length of time was perfectly solid, sound, and to all appearances as durable as ever. No time was

[1] Proceed. Acad. Nat. Science of Phila., June, 1831.

lost now in looking for its source on the mountain. The lower flanks of the range, less steeply inclined, with a rich, deep soil, are almost entirely under cultivation; the steep incline above the clearings, with its rock-covered ground, supports a fine forest of Mountain Oaks (*Quercus Prinus*), Chestnuts, Black Ash (*Fraxinus quadrangulata*), Elm (*Ulmus Americana*), Maples (*Acer saccharinum* var. *nigrum*), Mocker-nuts (*Carya tomentosa*), interspered with copses of Red Cedar (*Juniperus Virginiana*), with a dense undergrowth of trees of smaller size; Plums (*Prunus Americana*), Black Haws (*Viburnum prunifolium*), Hornbeam (*Carpinus Americana*), and various shrubs, *Rhus aromatica*, *Forestiera ligustrina*, etc. The heavy outcrops of this mountain limestone form on the steep declivity extensive ledges, and terrace-like shelves traversed by shallow ravines—their fragments, which cover the ground, making the access to these woods quite difficult. It was upon this rocky soil, amongst its varied forest vegetation, that the coveted object of my search was found growing. Not more than half a dozen trees of the same kind were found in this locality, scattered along one of the rocky ravines, measuring from 25–35 feet in height. The largest one felled measured 35 feet in length and 12 inches in diameter one foot above the ground.

Arrived at such dimensions, the tree has evidently long passed the best period of its life, judging from the decay by which, more or less, the trunk was found affected. No sign of a decline, however, could be observed in the vigor of its vegetation.

The trunk divides at a height from 12 to 14 feet above its base; the primary limbs are erect, the secondary branches widely spreading, often slightly reclining, smooth and divide into numerous divaricate reddish branchlets rugose from the base of the leaf-stalks of the previous season. The bark is rough, covered with a whitish gray epidermis of a deep chestnut-brown underneath, and exfoliating in oblong square scales of uniform size. The inner bark is white, exposed to the air turning rapidly to a deep yellow color, and exudes, when bruised, a resinous sap of a heavy, disagreeable terebinthinous odor. The wood is heavy, very compact, of a fine grain; the white sap wood of small proportion surrounds, as a narrow ring, the deep yellow hard wood, variegated by zones of different shades of brown, imparting to it a beautiful appearance when polished.

The leaves are from 2½ to 6 inches long, from 1½ to 3 inches

wide, broadly ovate, obtuse, slightly emarginate, and attenuate at the base, with a strong mid-rib prominent; primary veins of a purplish color, sparsely pubescent while young; perfectly smooth later in the season; of a bright green, with a soft, glaucous hue. The panicle is open, 8 to 12 inches long, and almost as wide, with horizontally-spreading branches, which, like the common peduncle, are smooth, subtended like its crowded, numerous ultimate divisions by marcescent, finally deciduous lanceolate bracts. The flower-bearing pedicels are erect, one inch or over in length, and sparsely hirsute. The shorter, almost capillary abortive divisions, are gracefully received and bent, densely plumose by long spreading jointed hairs of a purplish tint.

Flowers perfect, minute; calyx deeply five-parted, the lanceolate lobes veined and with a mid-rib little over one-half the length of the persistent, greenish white ligulate petals, which are inserted between the sepals and the thin, broad purplish disk. Stamens short. Ovary with 3 short lateral styles. Drupe hard, oblique, semi-obcordate, $\frac{1}{8}$ inch by its largest diameter; the coriaceous brownish epicarp prominently veined and reticulated, investing closely the tough testa. Cotyledons accumbent.

The inner bark and wood are used for dyeing yellow, and it is said, also, for the production of purple tints. On this point, however, no definite information could be obtained.

Large numbers of trees were cut down during the war to procure a dyestuff much valued at the time, and full-grown ones are now quite scarce near the settlements. On account of the beauty of its wood, the tree is called Shittim-wood by the negroes, they believing it to be same which was used in the construction of the tabernacle in Solomon's Temple. The wood permits of the finest finish; the fineness of its grain, beauty of color and its hardness fit it well for inlaid work, veneering, and the manufacture of smaller articles of all kinds of fancy woodwork.

As an ornamental tree it far surpasses the European species, and will be found quite as hardy.

On the 3d of May it was found almost past blooming, a few belated flowers allowed the examination of its floral organs. On the 29th, it had fully ripened its fruit, the panicle had begun to dry up, and its pedicels were already a prey to wind and weather. In searching for the flowering tree, extensive coppices were found on the southern slope of Mount Sano, east of Huntsville, the second

growth from numerous stumps of full-grown trees cut down during the last half century, to serve as kindling-wood. Its resinous wood burning easily with a bright flame, this rare and interesting tree is constantly sacrificed to such low purposes wherever found easy of access. Within the narrow limits to which it is confined, it would be doomed to rapid extinction if it were not for the production of numerous rapidly-growing sprouts, giving rise to a copious second growth. It produces seeds but sparingly, all efforts to produce seedlings or young trees for transplanting failed. It seems to be easily propagated by layers, judging from some accidentally prostrated limbs, which, where in contact with the ground, were found rooting.

As observed in this state, this tree appears principally confined to the southern declivities of the mountains, from the northern border of the valley of the Tennessee, and *strictly* to the habitat described. It was never found on the sandstone cliffs which but a short distance higher up overlay the limestone strata, nor lower down the mountain sides, where the soil is deep and rich. According to Prof. Buckley, stunted specimens were first seen by him near Ditto's Landing, on the southern bank of the stream. The writer failed to meet it in his travels through the mountain region bordering south upon the basin of the Tennessee River. It is said to extend northward into the State of Tennessee, following the flanks of the Cumberland Mountains in their northeastern trend.

AUGUST 1, 1882.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Fourteen persons present.

Summer Migration of the Robin.—Mr. THOS. MEEHAN remarked that Audubon, Nuttall, Wilson, and other eminent ornithologists, had suggested that the seasons had evidently not so much to do with the migration of birds, as the question of food, though most authors connected this question of food with the autumn or winter season. He said he had recently observed the migration of the robin (*Turdus migratorius*) in great numbers during the ten days prior to August 1, or on the evenings of those days, for the flight was from about sundown to dark. They came from the northwest, and were flying southeast. Some were but a few hundred feet, but others were so high as to be scarcely visible, which would indicate a long journey. Robins had abounded on his property in Germantown during the past spring and early summer. He might say, without exaggeration, there were many hundreds of them. On the day of this communication, August 1, it was rare to meet with one. He considered the question of disappearance wholly one of food. On his grounds there had been no rain of any consequence for two months. For two weeks past numerous trees and plants had to be kept alive by artificial watering. Examining the dry earth after the harrow, he found few signs of insect life. The cherry crop had been nearly a failure. The usual berried plants, such as dog-wood, on which they generally fed, were not ripe. There was really little for them to eat, and he had reason to believe that the same conditions prevailed all over northern Pennsylvania. In New Jersey, plants with berries were ripening, as they were also further south, and he concluded this search for food was in this instance the cause of the early migration.

Night-closing in the Leaves of Purslane.—Mr. MEEHAN noted that in the list of plants having diurnal or nocturnal motion, *Portulaca oleracea* did not appear. At sundown the leaves, at other times at right-angles with the stem, rose and pressed their upper surfaces against it. The morning expansion began with dawn, and soon after sunrise the leaves were fully expanded. Mr. Isaac Burk had also observed it, as also in an allied plant of the West Indies, *Talinum patens.*

AUGUST 8, 1882.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Fourteen persons present.

Colored Flowers in the Carrot.—Mr. THOS. MEEHAN remarked

that the umbellet of colored flowers in the centre of the umbel of the carrot, was represented as usually fertile in Europe and sterile in the United States. He had always found them sterile in the United States until this season, when he discovered that those in the centre of the first umbel of the season were fertile. Those in the umbels from lateral shoots were sterile. This had, no doubt, always been the case—the laterals probably being the only ones examined in former investigations.

AUGUST 15, 1882.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Fourteen persons present.

Heliotropism in Sunflowers.—Mr. THOS. MEEHAN exhibited flowers of *Helianthus mollis*, and remarked on the popular fallacy regarding sunflowers turning with the sun. The original "sunflower," connected with the Ovidian stories of Clytie and Phœbus, was the European heliotrope, and even that did not turn with the sun in the modern popular sense. It simply grew where the sun loved to shine, and the plant did not flower till the sun had reached its summer solstice. The tragical part of the mythological story is founded on the fact that the plant continued to open its flowers as the sun declined, or, as Ovid might say, its affection for its beloved was in proportion as the lover fled from her to his winter quarters. The *Helianthus* was named sunflower, simply because the flowers resembled the sun, and there is no relation between it and the sunflower of mythology. Yet there are peculiarities worth noting. Travelers across the American plains, where sunflowers abound, have often observed a great proportion of flowers facing one direction, but there were always some in other directions, and these exceptions seemed to prevent any generalization as to special points of the compass being favored more than others. He has growing in his garden, plants of *Helianthus mollis*, from seeds gathered by him some years ago from near Odin, in Illinois, and the flowers always seemed to have, to a great extent, a general southern leaning, but until this season he had not thought to make exact figures early enough to be satisfactory. This season he found the first flowers open on the 7th of August. The upper portion of the flower-stalk is curved, so that when the flower opens, some quarter of an inch of stem is at right-angles with the lower portion, and the face of the flower is exactly horizontal. It was subsequently found that the flower remained in this horizontal position till the last disk-floret had expanded, occupying about three days, when the whole head commenced to occupy an erect position, taking about three days more to fully accomplish. Commencing to open on the 7th of

August, by the 11th there were sixty-eight flowers expanded, all facing exactly southeast on opening; but on the evening of this day, three were found which had changed around to northeast, with a slight tendency up from the horizon. On the 14th, there were seventy-three flowers open, twenty-one of which faced northeast. On examining the matter carefully, the inclination to the north was found to be due to a slight spiral or uncoiling growth during the advance from the horizontal rest to the erect position. All do not do this, but uncurve rather than uncoil. While this accounted for the northward advance, often as much as ninety degrees in a number of flowers, it still left the reason for the original facing of the flower to the southeast, among the many problems of plant-life yet to be solved. He referred to the several reasons offered in explanation of polarity in the leaves of the compass-plant, pointing out the unsatisfactory character of all of them.

AUGUST 22, 1882.

The President, DR. LEIDY, in the chair.

Ten persons present.

AUGUST 29, 1882.

The President, DR. LEIDY, in the chair.

Twenty-three persons present.

SEPTEMBER 5, 1882.

The President, Dr. LEIDY, in the chair.

Thirty-two persons present.

A paper entitled "Conchologia Hongkongensis," by T. W. Eastlake, was presented for publication.

Vitality of Fresh-water Polyps.—Dr. H. ALLEN called attention to tenacity of life as exhibited in a fresh-water polyzoon (*Plumatella vesicularia*, Leidy). The leaf of the lily on which the colony had fixed itself, had been, by accident, removed from the water of the aquarium, and had been exposed for sixteen hours to the air. The animals had apparently become dry, and the colony itself barely visible to the unaided eye. Upon being again immersed (in water that chanced to be impregnated with iron-rust), the animals revived and flourished for two weeks, at the end of which time they perished from the effects of the decay of the leaf on

which they were growing. The following facts were thought to be of interest in this connection. First, that in these animals, relatively high in organization, aeration may go on for a number of hours by means of the retracted tentacles in the small amount of water contained within the cells. Second, that the presence of oxide of iron in the water does not interfere with the growth of the animals. And third, that the genus *Plumatella* may be found to resemble other mollusk-like creatures not only in their plan of organization, but in their habits of sustaining life for long periods after removal of the animals from water. The last-named fact may possibly enter into questions of geographical distribution of this and allied forms.

On Balanus, etc., at Bass Rocks, Mass.—Prof. LEIDY remarked that the Barnacle, *Balanus balanoides*, of which he presented a series of specimens from Bass Rocks, Gloucester Co., Mass., is found everywhere in the greatest profusion covering the rocks, between tides, on our eastern coast. It is also common on many other more or less fixed objects, such as shells of dead or living mollusks, lobsters and crabs, old wrecks of vessels, etc. The specimens presented are interesting from their exhibiting a remarkable variation in form, mainly due to the difference in the extent of room in which they grow. In general when isolated or with ample space, the shells are comparatively broad and low, and narrowed from their base of attachment to the aperture; or they are in the shape of short truncated cones, with the breadth as great or greater than the length. When crowded more or less close together, they assume a longer, narrower, cylindrical form, expanding towards the mouth; and thus they may become three or four times the length of the breadth, with the shape of a tubular corolla of a flower. They may be straight, variably curved and compressed. The series of specimens presented exhibit the following proportionate measurements:—

Height.	Breadth near the base—	expanding to —	and then contracting to the mouth.
27 mm.	3		7
27	4.5		8
26	3		8
26	6		9
26	6		8
25	2		6
21	7		9
20	5		12
27	6	9	8
24	8	9	8
23	9	11	9
19	7	10	8

Height.	Breadth at base —	and then contracting to the mouth.
12 mm.	12	10
11	10	8
10	13	10
8	15	8

The specimens of *Littorina litorea* and of *Purpura lapillus* presented were also collected at Bass Rocks where they occurred in great abundance, and appeared to be the commonest gasteropods of the locality. The former is described in the report on the Invertebrata of Massachusetts, of Gould and Binney, but the only locality given for it is Halifax, while it is not noticed as occurring at Vineyard Sound in the report of the U. S. Commission of Fish, Pt. i, 1873.

SEPTEMBER 12, 1882.

The President, Dr. LEIDY, in the chair.

Twenty-seven persons present.

The death of Wm. H. Allen, a member, August 29, 1882, was announced.

The following were ordered to be published:—

NOTICE OF DR. ROBERT BRIDGES.

BY W. S. W. RUSCHENBERGER, M. D.

Amidst the great population of the city, the Academy is comparatively a very small body; in fact, a mere company addicted to studies in which our fellow-citizens generally take not much interest; so little, indeed, that they hardly care to understand the nature of the work done in the institution, or to appreciate its value to the community.

General literature, the drama, music, the fine arts, attract and divert the people so satisfactorily that belles-lettres writers, poets, painters and sculptors who are skilful, are almost universally admired, and become celebrated widely and attain a higher position in public estimation than unobtrusive votaries of science, whose real worth is rightly appreciated solely by the few. Only pre-eminently great scientists and naturalists acquire position among the hosts of men distinguished because they have aided in some way the progress of civilization. The merits of individuals of the rank and file, whose labors contribute largely to the success and fame of the leaders, are too frequently overlooked.

The Natural Sciences occupy a boundless field. Its cultivation is endless, and, when a society undertakes it, requires laborers of almost every variety of qualification and degree of intelligence. Properly mounting, labeling, classifying specimens in the museum, and cataloguing and arranging books in the library for ready reference may be done by persons not qualified to recognize or describe new species; yet this comparatively inferior kind of work is of much value in facilitating the labors of those engaged in other parts of the field. The discovery and definition of new genera and species, though of very great importance, are not the sole objects of the society's pursuit. Successful generalization demands a different kind of intelligence and more extensive acquirements than special description of forms.

A good name properly earned by an individual in any department of our little community is in itself a contribution to the fair reputation of the Academy; and this is worth consideration, because the good name of the institution carries with it an influence which is important to its progress and prosperity. A good

name, therefore, is among the valuables of the corporation, to be transmitted to future members, as a common inheritance. One who contributes towards the advancement of science, either directly or indirectly; who leaves the Academy in better condition because he has passed part of his life in it, is surely worthy of remembrance. Whenever one dies who has attained distinction within our little world, through his services to the common cause, a suitable record of his worth should be made, that his successors may know to whom they are indebted and be reasonably grateful. There have been and there are now members, who, on account of their contributions towards the advancement of science and the progress of the society, are entitled to more than ordinary respect—men whose conduct is worthy of admiration and imitation, at least by all those who have like scientific tastes and tendencies.

The records of the society show that among these Dr. Robert Bridges held a prominent place. A sketch of his career in the Academy only is offered here.

He was born in Philadelphia, March 5, 1806, and died in this city, February 20, 1882, at the age of very nearly seventy-six years.

Dr. Robert Bridges was elected a member of the Academy of Natural Sciences of Philadelphia, January, 1835.

His first work was an *Index of the Genera in the Herbarium*, prepared by him and Dr. Paul B. Goddard, which he presented to the Academy, August, 1835.

He was elected Librarian, June 28, 1836, and served till May 28, 1839—two years and eleven months—when he resigned. He assisted in preparing and printing the first catalogue of the library. The Academy presented its thanks to him for "the able and efficient discharge of the duties of librarian."

In the course of the years 1839–40, he served as Recording Secretary *pro tempore*, during five months.

He was elected Corresponding Secretary, May, 1840, and served till December, 1841, one year and seven months.

He was a Vice-President from September, 1850—succeeding Dr. R. Eglesfield Griffith, who died June 26—till December, 1864, fourteen years and three months, when he was chosen President. He declined re-election, December, 1865.

He was an Auditor six years, from December, 1843, till December, 1849.

He was a member of the *Publication Committee* from December, 1837, till December, 1838; and again from December, 1849, till December, 1872, when he declined re-election, having served twenty-three years. He was chairman of the committee from December, 1865, till December, 1872.

He was a member of the *Library Committee* twenty-nine years, from December, 1842, till December, 1871, and chairman of it from December, 1846, till December, 1853.

He was a member of the *Committee on Proceedings* seven years, from January, 1862, till January, 1869; and of the *Finance Committee* five years, from December, 1869, till December, 1874.

He was elected a member of the *Botanical Committee*, January, 1836, was chairman of it from December, 1846, and served till December, 1857, twenty-one years, when he declined re-election. For his official services the Academy voted him its thanks, December 28, 1841. On the 23d of May, 1843, he presented a *New Index of the Herbarium*, and one of *Menke's Herbarium*, from the Committee, a work which was long the main guide to the botanical collections.

He was elected a member of the *Committee on Entomology and Crustaca*, January, 1849, became chairman of it January, 1858, and served till December, 1865, seventeen years. He labeled, catalogued and arranged anew the collection of Crustaca according to the nomenclature and classification accepted at that time as the best.

He was nine years a member of the *Committee on Herpetology and Ichthyology*, from January, 1857, till January, 1866, and was chairman of it from January, 1860.

He was elected, January, 1866, a member of the *Committee on Physics;* became chairman of it, January, 1868, and served till May, 1876, ten years and four months.

He was a member of the *Committee on Chemistry* five years and four months, from December, 1870, till May, 1876, when all the standing committees were abolished.

Under the By-Laws adopted May 25, 1869, a Council was created. Dr. Bridges was elected a Councillor, December 28, 1869, and served till May, 1876, six years and four months.

A committee was raised, June 30, 1846, to devise means of accommodating the Duc de Rivoli's collection of birds, which had been just purchased by Dr. Thomas B. Wilson. Dr. Bridges was

appointed a member of the committee, which reported, August 4th, a plan for extending the building thirty feet westward. The report was adopted, and the committee, then made the Building Committee, was instructed to execute the plan.

Again, December 30, 1851, Dr. Bridges was appointed a member of a committee to solicit subscriptions to enlarge and improve the hall. The committee reported, January 25, 1853, that the estimated sum required had been subscribed. Dr. Thomas B. Wilson, Dr. Robert Bridges and Mr. Wm. S. Vaux were appointed a Building Committee to execute the plans of improvement. In behalf of the committee, Mr. Vaux reported, December, 1855, that the work of raising the previously enlarged building twenty-four feet had been completed at a cost of $12,263, which had been paid.

Dr. Bridges was appointed, December 26, 1865, one of a Committee of forty members to solicit subscriptions to erect a fireproof building for the use of the Academy, and he was elected, January 8, 1867, a member of the Board of Trustees of the Building Fund, and by it, January 11, 1867, a member of the Building Committee, in which he was active till the society was established in its new hall, January, 1876.

Besides serving the society as Librarian, Recording Secretary, Corresponding Secretary, Auditor, Vice-President and President, member of numerous Standing Committees, as well as of very many Special Committees, he contributed to its funds, to its library and to its museum. In all the many years of his activity he was rarely absent from the meetings of the Academy, and discharged all duties imposed upon him promptly and efficiently.

His numerous official services, presented here in summary, imply that he had the kindly respect and confidence of his fellow-members; and it may be said that the record of his labors expresses all the eulogium required. Almost all his time not occupied by his professional avocations was employed, during more than forty years, in working faithfully, disinterestedly, to promote the acquirement and diffusion of knowledge of natural history which are the chief purposes of the society. He was remarkably courteous to students, and always seemed pleased to assist them in their inquiries and pursuits. His learning was varied and extensive and minutely accurate, but he was so modest, unassuming, that it was necessary to apply to him for information to perceive the

wealth of knowledge at his command. He was an expert chemist, a good botanist, and well versed in almost all the natural sciences; yet he published little, and seldom engaged in debate. But his good sense and independent judgment, his rigid probity and loyalty to truth in every aspect, his punctual faithfulness to all obligations, his cheerful and benevolent disposition and tranquil deportment at all times, combined to render his presence in the society a beneficial influence on its progress, an influence which cannot be made manifest by instances or definitely measured.

His interest in the Academy was unremitting till the close of his life. After impaired health prevented him from being active in its affairs and from being present at the meetings, he often found recreation during the day in passing hours reading in the library.

The Academy has had among its members many distinguished, and some wealthy and beneficent friends, but none more constant, none who has worked more industriously and efficiently for its advancement than Dr. Robert Bridges. His givings to it were as generous as his comparatively narrow circumstances justly allowed. No striking invention, no discovery in science is ascribed to him, but laboriousness, sincerity of purpose and faithfulness were so manifest in all his ways that he had the confidence of all. He earned for himself a good name in the society, and is entitled to be long remembered among us, kindly and respectfully.

CONCHOLOGIA HONGKONGENSIS.

BY T. W. EASTLAKE.

The recent publications of Dr. O. F. von Möllendorff and Père Heude, S. J., have thrown a new light on the conchology of the Yangtze-kiang River, and some of the provinces of Southern China, in a very welcome manner. The land, whose conchology found its pioneers in Swinhoe and Fortune, is becoming daily better known to the scientists of Europe. Indomitable energy and steady perseverance on the one hand, together with the keen eye of the scientific traveler on the other, are establishing the zoology of China—immense as is that country—on a firm scientific basis. Still there is a wide field for investigation. The transition stages of the zoology of Central Asia into that of Western China, have yet to be carefully examined. Again, some branches have been almost totally neglected. The entomology of China is only known through the medium of Donovan's "Insects of China," a work which, at present, has but little more scientific value than that of a child's picture-book. Until recently, conchology was still worse represented. A few remarks in the itineraries of passing scientists, a chapter or two in the chronicles of occasional expeditions, a short paper in the transactions of zoological societies—these were the only sources from which any knowledge of the conchology of China could be gleaned.

Under these circumstances, the publication of the "Mémoires concernant l'Histoire Naturelle de l'Empire Chinois," is heartily welcome, and great credit is due to Père Heude for his "Notes sur les Molluscs de la Vallée du Fleuve Bleu." Still one cannot refrain from regretting that the Rev. Father has undertaken such a work without a thorough knowledge of conchology itself—a neglect which is strongly apparent in the occasional confusion of similar genera, and the application of new names to old and well-known species. In this manner, no less than seven of Père Heude's *Clausiliæ* resolve themselves into varieties of *Clausilia aculus*, Benson, originally found in the Chusan Islands by Swinhoe, and later at Kiu-kiang by von Möllendorff. Père Heude's work adds over one hundred new species to the land shells of the Yangtze-kiang.

Of far greater scientific value are Dr. von Möllendorff's papers, which have appeared in the publications of the "Malakozoologische Gesellschaft," of Germany, and in the Transactions of the Bengal Branch of the Royal Asiatic Society. Von Möllendorff is a thorough scientist, and his new work on the "Conchology of Southern China" (shortly to appear) promises to be indispensable as a text-book.

It is remarkable that the Island of Hongkong should have produced so many indigenous species. A British possession for more than thirty years, hardly one scientific expedition has touched the shores of this "barren rock in the ocean," without discovering a new species. Of late years, Drs. von Möllendorff, Hungerford, and the writer, have carefully gone over the greater part of the island, not only discovering new species, but rediscovering others which had disappeared since Stimpson's visit to Hongkong—nearly thirty years ago.

There are only a very few places where shells are to be found, as the larger part of the island consists of naked rocks, or is sparsely covered by *Gleichenia dichotoma*—a fern which is a sure indication of the absence of terrestrial mollusca. In the valleys, however, vegetation is luxuriant, and it is in these places that most of the shells are to be found. The dense woods of Little Hongkong (a Chinese village about 6 miles from the colony), and the little valley near Sheko (10 miles from the colony), are favorite resorts for collectors. Curiously enough, one of the highest peaks on the island, known as High West (1608′) is the only place where some of the rarest species are to be found, in especial *Helix pulvinaris*, Gould, and *Cyclotus Chinensis*, Pfeiffer. The whole eastern side is covered with a dense growth of small ficus, acanthaceæ, and orchidaceous plants, and these, protected from the violence of the northeast monsoon, form a favorite shelter for the mollusca. Unluckily, the peak is only accessible from the south, and thus almost the entire eastern side is beyond reach. Still, one can descend safely thirty or forty yards below the peak, although great precaution is necessary, for granite boulders abound, and the slippery, as well as insecure footing these afford, renders a greater descent impossible.

The following is a rough list of the land snails found on the island:—

Cyclophorus exaltatus, Pfeiffer — Little Hongkong.

This is the commonest species of the Cyclostomidæ, and is not confined to the island, having been found by the writer some distance in the interior of the Kwang-tung province. Found in Hongkong by Fortune; later by E. von Martens. Reeve, in his Conchologia Iconica confounds *C. exaltatus* with *C. volvulus* (*lituus*) from Siam. That they resemble each other is true, but *C. exaltatus* is always smaller, the shell is thinner and without a ridge about the umbilicus. Closely related to this species is *C. Martensianus*, v. Mlldff., found at Kiu-kiang by von Möllendorff and Père Heude; by the writer at the Yung-fu monastery, Fukien province. Cf. Jahrb. I, 1874, p. 78; II, 1875, p. 120. E. von Martens, ibid., p. 127.

Cyclophorus pellicosta, von Möllendorff. — High West.

Originally described from the Lo-foo-shan, a range of mountains near Canton City. Rare.

Cyclophorus trichophorus (Craspedotropis), v. Mlldff. — Little Hongkong.

Described originally from the Lo-foo-shan, near the monastery of Washau. Since found by Dr. von Möllendorff at Ding-hu-shan. (Kwang-tung province), and at Little Hongkong by the writer.

Cyclophorus (Leptopomoides) cuticosta von Mlldff.

Found first in Hongkong by Drs. von Möllendorff and Hungerford, again at Tong-chow, not far from Macao, by Dr. Hungerford and the writer; finally, near the monastery of Yung-fu, in the Fukien province, by the writer.

Cyclotus Chinensis, Pfeiffer. — High West.

Had disappeared since 1850; rediscovered by Dr. von Möllendorff.

Alycaeus pi'ula, Gould.

For many years this shell was supposed to have disappeared from Hongkong, but it was the writer's good fortune to find a solitary specimen on High West (July 16, 1882), a description of which will shortly be published by Dr. von Möllendorff. E. von Martens (Jahr. II, 1875, p. 127), writes that the species is not known to him either through an engraving or any specimen. It is closely allied to *Alycaeus Kobeltianus*, found by von Möllendorff at Kin-kiang.

Paxillus tantillus, Gould.

This species has never been found since Stimpson's visit to the island. It may, however, exist in the woods near Little Hongkong.

Helicina Hungerfordiana, von Mlldff.

Found at High West (Hongkong) by Dr. Hungerford, Dr. von Möllendorff, and the writer; at Tung-chow (near Macao) by Dr. Hungerford and self.

Helicarion imperator, Gould. Sheko and Little Hongkong.

In 1875 only five specimens were known in Europe. Confined to Hongkong.

Helix similaris, Ferussac. Common.

H. similaris, Fer. Prod., 1821; **H. Hongkongensis**, Desh.; **H. obscura**, Desh.

There are evidently two varieties of this shell in Hongkong. The larger approaches somewhat *H. ravida*, Benson. Deshayes' description of *H. Hongkongensis* proves that he was unacquainted with the latter variety.

Helix Gerlachi, von Mlldff. High West.

Originally described from the Lo-foo-shan.

Helix xanthoderma, von Mlldff. Sheko.

One of the rarest and largest shells of the island. Indigenous to Hongkong.

Helix (Corilla) pulvinaris, Gould. High West.

Exception may be taken to the clause of the description "dentibus extus non conspicuis," as the teeth are distinctly visible through the aperture, as well as through the delicate shell itself. One dead specimen picked up on the mainland opposite to the island, considerably exceeded the size indicated by Gould.

Helix cicatricosa, Müller. Hongkong.

Originally from the Lo-foo-shan, now to be found in the Botanical Gardens of Hongkong, whither it has evidently been transplanted.

Helix trisinuata, Martens. Sheko.

Very rare. On the opposite coast, about seven miles from the island, the writer found a *Helix*, which, though closely connected with *H. trisinuata*, yet presented striking peculiarities. This has been named *H. Eastlakeana* by Dr. von Möllendorff, for a description of which see the "Jahrbücher der Malakozoologischen Gesellschaft," 1881. The described *Helix* is still unique.

Helix, nova species, undescribed. High West.

Helix (rufiorissa, von Mlldff.), nova species, undescribed. Little Hongkong.

Microcystis Schmackeriana, von Mlldff.

Found in Hongkong (near Aberdeen), by Herr Schmacker; in the Lo-foo-shan Mountains by Dr. von Möllendorff; at Low-da on the Yung-fu River, province of Fukien, by the writer.

Helix (an Cochlostyla?) xanthoderma, von Mlldff.

A. typus? Diam. maj. 50, min. 43, alt. 45 mm.

Habitat ad Montem Ma-on-shan, provinciæ sinensis Kuang-tung.

B. forma minor. Diam. maj. 44, min. 37, alt. 40 mm.

Habitat in insula Hongkong (Sheko).

Stenogyra (Opeas) Fortunei, Pfeiffer. Common.

Fortune found this shell near Shanghai, and Canton, according to Reeve, in Macao (I have not found it there). There is considerable doubt whether the Hongkong *Stenogyra* is in reality *Fortunei;* that it closely approximates the typical shell is beyond question.

Stenogyra (Opeas) chinensis, Pfeiffer. Common.

Clausilia lorraini, Mencke. Sheko.

Tolerably abundant; confined to the Sheko Valley.

Streptaxis sinensis, Gould. High West and Little H.

Tolerably rare. Best specimens from Little Hongkong. Found also at the Lo-foo-shan and elsewhere in the province of Kwangtung.

Ennea bicolor, Hutton.

This shell is one of the widest-spread of the Gonospiræ, having been found in Burmah (Gould), Cochinchina (Michau), Mauritius (Benson), St. Thomas (Bland), and according to Benson, in Ceylon. Hutton first described it from Mirzapoor. In Hongkong this beautiful *Ennea* is quite rare, and has been found in Sheko by Dr. von Möllendorff.

Succinea chinensis, Pfeiffer. Botanical Gardens.

This *Succinia* seems never to attain any large size in Hongkong. Specimens from Amoy and Swatow in the writer's collection are much better developed, and more characteristic of the species.

Macrochlamys superlita, Morelet. Sheko.

Perfect specimens very rare, as the shell is extremely fragile.

Besides the list given above there are two Microcystis, as yet unnamed. One *Microcystis* (*Eastlakeana*, v. Mlldff.), found by the writer near Little Hongkong; the other tolerably common on old walls and trees throughout the N. E. portion of the island. Also one *Conulus*, frem High West, undescribed.

Fresh-Water Snails.

Limnæa ollula, Benson.	Streams near L. Hongkong.
Limnæa plicatula, Benson.	Streams near L. Hongkong.

This latter species is by far the rarer of the two. A variety of *L. plicatula* has been found by Dr. v. Möllendorff and the writer on the mainland, some twenty miles from Hongkong.

Planorbis compressus, Benson.	Streams near Aberdeen.
Planorbis Cantori, Benson.	Victoria Peak.
Corticula lutea, Morelet.	Near Sheko.

Of slugs there are only two species found on the island.

Philomicus bilineatus, Benson.

Vaginulus chinensis, v. Mlldff., nova species.

Pallium supra confertim minute granulatum, obscure cinereo-fuscum, maculis pallide fusco-flavidis ad margines crebrioribus sparsum, medio striga flavida parum distincta notatum, infra pallide flavogriseum, unicolor, pes flavidus. Tentacula superiora nigra, inferiora pallida.

Pallii long. 75, lat. 15; pedis lat. 5, tentac. sup. 6, inf. 3 mm. In hortis insulæ Hongkong.

SEPTEMBER 19, 1882.

The President, Dr. LEIDY, in the chair.

Thirty-four persons present.

A paper entitled "Verification of the Habitat of Conrad's Mytilus bifurcatus," by R. E. C. Stearns, was presented for publication.

SEPTEMBER 26, 1882.

The President, Dr. LEIDY, in the chair.

Twenty persons present.

A paper entitled "Rotifera without Rotary Organs," by Prof. Jos. Leidy, was presented for publication.

On the Tobacco-worm, etc.—Prof. LEIDY exhibited a collection of tobacco-worms, the larvæ of *Sphinx carolina*, which he had obtained two days ago from a tobacco-field, near Columbus, New Jersey, where they were very abundant, and had proved a great pest in the cultivation of tobacco. The worms collected presented a number of well-marked varieties, which were supposed to be all of the same species. The principal ones were indicated as follows:

1. Pea-green or yellowish green, more or less finely hairy, with lateral oblique white bands bordered above with black dots which extend to the dorsal median line; head bright pea-green, dorso-caudal spine red. This is the most common variety.

2. Pea-green, smooth, with lateral oblique white bands joined in front below by horizontal white bands so as to form a series of ⊳-like marks, the apex of each joining the lower limb of the one in advance; head green; dorso-caudal spine black.

3. Grass-green, smooth, with lateral white V-like marks as in No. 2; the oblique bands bordered above by blackish or brownish; upper part, especially in front, more or less dotted with white; head green, with a pair of black bands on each side; dorso-caudal spine black.

4. Yellowish green, annulated with narrow black lines; with lateral white V-like marks, the oblique bands bordered above with black; head bright pea-green; dorso-caudal spine red.

5. Dull green, with more or less brown dorsally and dotted with white, the dots more or less tuberculate, but otherwise smooth; with lateral white V-like marks, the oblique band bordered above with brown ascending to the dorsal median line; head green with a lateral pair of black bands; dorso-caudal spine black.

6. Chocolate-brown to nearly black, smooth, with white dots dorsally and anteriorly, with lateral white V-like marks; head shining black on each side; dorso-caudal spine shining black.

7. The same as No. 6, with lateral red V-like marks.

Among these more marked varieties others were noticed which were more or less of an intermediate character. The most common variety was that which was least distinguishable in color from the animal's location, the tobacco-leaf, so that it was especially favored in its preservation.

Prof. Leidy further remarked that the past season had appeared to be favorable to many of the Lepidoptera. Our shade-trees had been greatly ravaged by the *Orgyia;* many of the poplars had suffered from the *Clostera inclusa*, and he had observed an unusual quantity of the Ailanthus silk-worm, *Attacus cynthia*, upon the Ailanthus-trees. The latter was introduced here in 1861, by Dr. Thomas Stewardson.

Dr. Wm. M. Gray was elected a member.

OCTOBER 3, 1882.

The President, Dr. LEIDY, in the chair.

Twenty-seven members present.

Apparent Bird Tracks by the Sea-shore.—Mr. THOMAS MEEHAN called attention to what appeared to be the track of a three-toed bird in the sand, near low-water mark, at Atlantic City. They were generally regarded by observers as bird tracks. While looking at them, recently, he noted that there were no birds about to make such recent tracks, and also that the tracks would have to be made in every case by a bird facing the water, which, in the nature of things, would be improbable. While reflecting on this, he noted on the face of the smooth receding waves, spots where the water sparkled in the light, and he found this was caused by little riplets as the wavelet passed down over the half exposed bodies of a small crustacean, *Hippa talpoidea*, and that the water in passing over the bodies, made the trifid marks which had been taken for impressions of bird's feet. This little creature took shelter in the sand near low-water mark, and entered head foremost in a perpendicular direction downwards, resting just beneath the surface. The returning wave took some of the surface sand with it, and thus the lower portions of the bodies, uppermost in the sand, were exposed. Often the creatures would be entirely washed out, when, recovering themselves, they rapidly advanced in a direction contrary to the retreat of the wave, and entered the wet sand again as before, their sides being parallel with the shore. The body terminated in a caruncular point which, with the posi-

tion of the two hind-legs, made a tridentate obstruction to the sand brought down by the retreating wave, and the water passing around the points made the three toe-like grooves which resembled a bird's foot from one and a half to two inches long. The creatures in their scrambles for protection beneath the sand, managed to keep at fair distances from each other, and hence there was considerable regularity in the tracks as if they had really been produced by birds.

He added that he presented the observation as a mere trifle, but he could not help remarking that if by any means these trifid impressions should get filled with mud, and the deposit become solid rock, it would be very natural for observers, ignorant of their origin, to mistake marks like these for the tracks of birds.

Scent Organ of Papilio.—Mr. H. SKINNER remarked that the larvæ of *Papilio turnus* and *P. troilus* when irritated, project from a slit in the prothoracic segment, an orange-colored bifid organ. The apparatus is a scent organ, and gives out a strong and disagreeable odor perceptible at some distance, and seems to be designed to defend the caterpillar from numerous enemies.

The anatomy of the organ seems to have escaped investigation, as most authors merely mention its existence, one describing it simply as fleshy. It has the appearance of being a solid organ, but it is in reality hollow throughout the entire extent, and of very thin texture, tapering gradually to a point. It is drawn in by invagination, and is protruded after the same method. If the larvæ be held so that the sunlight may pass through the extended organ, the process of intussusception may be distinctly seen.

Asymmetry of the Turbinated Bones.—Dr. HARRISON ALLEN, in the course of remarks on the asymmetry of paired structures in mammals, invited the attention of the members to asymmetry in the inferior turbinated bones of the human subject. This asymmetry may exist independently of the deflection of the nasal septum, and may involve the entire length of the bones. The nasal chamber may also be asymmetrical, and even the choana of one side be much smaller than the space of the opposite side. It was thought that such asymmetry involving the pterygoid processes of the sphenoid bones, was due to early and probably pre-natal influences, as opposed to the asymmetry due to acquired deflection of the septum.

Some peculiarities of the floor of the nose which have not been described, were defined. Among these was mentioned the elevation of the premaxilla as it lies on the floor of the nose above the level of the horizontal plate of the superior maxilla. This elevation tended to conceal the inferior turbinated bone from inspection from the anterior nares. Some forms of obstruction to nasal respiration in man were thought by the speaker to be due to the conformation of the parts as described. A peculiar thickening of

the horizontal plates of the palatal bone, which was thought to be within the range of normal variation, was next mentioned.

The erectile character of the mucous membrane of the nasal chambers, while best developed upon the middle and turbinated bones, is also present about the organ of Jacobson. This phase of the erectile tissue, while rudimental in the human subject, is highly developed in the lower mammals, and is especially conspicuous in the domestic cat. Microscopical sections of the organs with their related erectile masses were exhibited, and attention invited to the probable use of the masses in guarding the anterior orifices of the nasal chambers. The erectile tissue may be said to open or close the orifices from within as the adductor and the abductor muscles of the wings of the nostrils may close or open them from without.

The following were ordered to be printed :—

VERIFICATION OF THE HABITAT OF CONRAD'S MYTILUS BIFURCATUS.

BY ROBERT E. C. STEARNS.

In the late Dr. Philip Carpenter's Report to the British Association (1856) on the Mollusca of the West Coast of North America, paragraph 39, occur these words:

"During the years 1834–5, Thomas Nuttall, Esq., for many years Professor of Natural History at Harvard University, Cambridge, U. S., visited the then almost unsearched shores of California, by a journey across the Rocky Mountains, under the escort of a trading company. Although his object was principally botanical, his love of natural science induced him to collect all the shells he could meet with; and with such good success, that many of his species have not to this day been again discovered. The peculiar interest attaching to his researches is, that he did not visit any part of the coast north of Oregon or south of San Diego. There is no danger, therefore, of any admixture with the shells of the Gulf district; and his collections may be regarded as the type of the Californian fauna strictly so-called. Leaving the American shores, Mr. Nuttall visited the Sandwich Islands, whence he only brought one species belonging to the American fauna, viz., *Hipponyx Grayanus*, on a *Pinna*.

"On his return to the United States, *via* Cape Horn, the description of the marine shells was undertaken by Mr. T. A. Conrad, and the land and fresh-water species by Mr. Lea. The latter gentleman communicated his paper to the American Philosophical Society, where it will be found in the 'Transactions,' vol. vi; Mr. Conrad read his paper before the Academy of Natural Sciences of Philadelphia, in January and February, 1837. It is published in the second part of the 'Journal' of the Society, vol. vii, pp. 227–268.

* * * * * * *

"The work bears the appearance of undue haste, * * * the localities cannot always be depended upon, * * * and the descriptions being in English would not have been entitled to claim precedence, were it not that they are accompanied by tolerably recognizable figures."[1]

[1] Jour. Ac. N. S., v. 7, Pl. 18, f. 14. Sp. 2184, Jay's Cat., p. 77, 4th ed., 1852.

On page 109 of the same (1856) report of Carpenter's, he gives *Mytilus bifurcatus*, Conr., Jay, 2184, "Sandwich Is."—"on rocks, bare at low water—Conr."; and adds: "No knowledge of the locality of this shell exists, except the statement of Conrad, which alone is not binding, and its appearance among the Mexican War shells, the collectors of which brought home nothing from the Sandwich Islands."

On page 563, in paragraph 62, of Carpenter's second report (1863), in commenting on the species and figures in Reeve's "Conch. Ic.," he prints as follows: "41, *Mytilus bifurcatus*, Conr., J. A. N. S. Phil., Hab.? [Conr. assigns his Nuttallian species to California; but it is the common Sandwich Is. species, teste Pse. The Californian shell, with the same sculpture, is a *Septifer*, and is the *S. bifurcatus* of Mus. Cum.]"

So far as regards the Sandwich Islands form, at this moment I am without specimens for comparison, and am satisfied with Pease's identification as to close resemblance. While Conrad was very often somewhat careless in his work, in the case before us he was correct, and Carpenter's criticism in this instance was not deserved, as *both Septifer* and *Mytilus*, that is to say both Reeve's and Conrad's species, are found at San Diego, and an examination of numbers of specimens collected by different parties during the past ten years, shows that an examination of the *interior* of the valves is necessary in order to determine to which group specimens belong. I have been unable, after the most careful inspection, to find any external differences by which I could separate them.

The *Septifer* from the Gulf of California, in the Xantus collection No. 118 = 169 of the Mazatlan Catalogue, I am not familiar with, and would suggest its comparison with *S. bifurcatus*, but Carpenter's *Mytilus multiformis*, No. 117 of the Xantus list = 169 of the Mazatlan Catalogue, I should regard as the southern form of Conrad's *Mytilus bifurcatus*. Specimens of the two species are contained in my collection, in that of the Philadelphia Academy, and in the National Museum, Washington.

ROTIFERA WITHOUT ROTARY ORGANS.

BY PROF. JOSEPH LEIDY.

The Rotifera or Wheel-animalcules, form a small class, abundant in kind and found almost everywhere in association with Algæ, and with Infusorians to which they were formerly considered to belong. Later they have been recognized as not having the simple cell structure of the latter, and for a time were regarded as pertaining to the Crustacea. They are now commonly looked upon as belonging to the group of Worms, but their relative position cannot yet be considered as positively determined. They generally possess a chitinous integument with a more or less annulate disposition or tendency to articulate division; but they are destitute of limbs. Some are provided with a carapace and recall crustacean forms, but in other points they exhibit but little likeness to them. Their usually striking characteristic, the rotary disks, from which they are named, is not possessed by any well-marked Crustacean. Among the Rotifera, however, there appear to be some which do not possess the rotary organs, at least in the mature condition, and yet in all other respects the animals conform in structure with ordinary forms.

Dujardin (Infusoires, 1841, 653, Pl. 22, fig. 2) was the first to describe a Rotifer destitute of rotary organs, to which he gave the name of *Lindia torulosa*. It is a free, swimming, worm-like, telescopic form, common in the class.

Gosse (Annals and Mag. of Nat. Hist., 1851, viii, 199) described an allied form, without rotary organs, under the name of *Taphrocampa annulosa*.

Cohn (Zeits. f. wissens. Zoologie, 1858, 287, Taf. xiii, fig. 1, 2) described a Rotifer resembling *Lindia*, but possessing rotary organs. He supposes it to be the same; and suspects that in the animal observed by Dujardin, the rotary disks had been withdrawn, in a manner common to the class. He remarks that the existence of a Rotifer, without vibratile cilia, would be a rude abnormity in the class, the more so because the possession of cilia is the most important character which separates the Rotifers from the Crustaceans.

In a marginal note I find that some years ago, at Newport,

R. I., I observed a Rotifer apparently devoid of rotary organs, which I took to be the *Lindia* of Dujardin.

However, even previously to Cohn's communication (see these Proceedings, 1857, 204), I described an animal which I regarded as a Rotifer, without doubt entirely destitute of the characteristic rotary organs or any trace whatever of vibratile cilia. It was named *Dictyophora vorax;* and it is quite different in form from the preceding animals. It is spheroidal, inarticulate, without carapace, or jointed tail; and possesses a large protractile and retractile pouch or cup, as a substitute for the ordinary rotary disks. It is attached to fixed objects, and has been observed on several occasions adherent to stones and the glass of an aquarium. The description of the animal, unaccompanied by illustration, seems never to have attracted attention.

Some years subsequently, Meczinchow (Zeits. f. wis. Zoologie, 1866, 346, Taf. xix) described a similar Rotifer to mine, under the name of *Apsilus lentiformis.* It was found, at Giessen, attached to the leaves of *Nymphæa lutea.* It is larger than *Dictyophora*, and differs mainly in the possession of bristled tentacles ("Gefühlorgane") and a ganglion to the pouch, neither of which were observed by me in *Dictyophora.*

The following year, Claparede (An. d. Sc. Nat., 1867, viii, 12, Pl. 4, figs. 3, 4) described another Rotifer, without the characteristic organs, under the name of *Balatro calvus.* It resembles the earlier described forms, and was observed to be parasitic on worms, in the River Seime, Canton of Geneva.

A short time since, Mr. S. A. Forbes (Am. Month. Micros. Jour., 1882, 102, 151), of Normal, Illinois, described a Rotifer, destitute of rotary disks, with the name of *Cupelopagus bucinedax.* It was found attached to the glass of an aquarium, and it appears to me to be so nearly like *Dictyophora vorax*, that I suspect it to be the same.

More recently, while examining some *Plumatella diffusa* from the Schuylkill River, below Fairmount dam, my attention was attracted to several groups of *Megalotrocha alba*, attached to the tubes of the former, and surrounding another animal of strange and novel character. This on examination proved to be another remarkable Rotifer, without rotary organs, and it is the interest which attaches to this discovery which has led to the present communication. As with many analagous things, I had not the

leisure to give it due study, and yet I felt that if I reserved it for future investigation, I might never meet with a more favorable opportunity for the purpose.

The new Rotifer I propose to name *Acyclus inquietus*, from its being destitute of wheels, or ciliated disks, and from its apparently restless habit. It is considerably larger than *Megalotrocha*, measures nearly a half line long, and can readily be distinguished, in groups of the latter, with the naked eye. It was observed in eight instances, in each, alone and always enclosed in a group of the *Megalotrocha*, above which, from its greater size, it towered like a giant in a crowd. In its constitution, for the most part it resembles *Megalotrocha*, and is attached in the same manner. In its movements it bends rather abruptly in different directions and curves downward so as to bring its prehensile mouth on a level with the currents produced by the rotary disks of the surrounding Megalotrochæ. Sometimes alone or in company with the latter, it suddenly contracts and then more slowly elongates and resumes its bending motions, scarcely for a moment appearing in an erect attitude. Occasionally it will even double on itself to such a degree that the extremities are approximated, or as the motion is commonly expressed, the head nearly touches the end of the tail or point of attachment. The movements of the creature recalled to me those of the avicularia of some of the marine Polyzoa, or of the pedicellaria of Echini.

At one time I had the opportunity of seeing an individual of *Plumatella* with outspread arms, and in its immediate vicinity a group of Megalotrochæ with open disks and an *Acyclus* in its midst, together with two worms of the genus *Dero*, with extended and expanded branchial tails, all acting together in concert, apparently perfectly regardless of the presence of one another—messmates partaking of the same repast.

Acyclus is translucent whitish with the thicker part of the body yellowish or brownish, due to the color of the capacious intestine shining through the integument. It was difficult to obtain a clear and accurate view of the exact mode of attachment and the internal structure of the animal, from its incessant motions, its becoming wrinkled in contraction, and from its being obscured by the surrounding bunch of Megalotrochæ. In the attempt to remove these, the *Acyclus* was detached and then would contract to such a degree, that nothing could be determined as to the arrangement

of its organs. Under the circumstances the accompanying figure 1, Plate II, of the animal, is to be regarded as only approximately correct. Most of the individuals seen were naked, like *Megalotrocha*, but had adherent a profusion of eggs. In two instances the animal was included in a copious colorless gelatinous sheath, as represented in the figure, but had also adherent a large bunch of eggs, in one of which bunches I counted upwards of fifty.

The head of *Acyclus* substitutes the rotary disk of the *Megalotrocha* and other Rotifers provided with this organ. It is in the form of a cup prolonged at the mouth into an incurved beak, as represented in figures 1–4. It is retractile and protrusile, contractile and expansile. When protruded and expanded the mouth gapes widely, and the beak becomes more extended, but always remains incurved. The mouth is bordered by a delicate membrane extending to the rounded end of the beak and presenting a festooned appearance. In contraction of the mouth the marginal membrane becomes inflected, the orifice constricted, and the beak more incurved. In contraction of the head or oral cup, it is reduced to half the bulk of its expanded condition, while the mouth is constricted and the beak is rolled in a single spiral inwardly as seen in figures 2, 3.

The extension of the head below forms a narrowed and transversely wrinkled neck which expands into the body. The expansion and contraction of the head appear to be due to the flow of a milky liquid between the cœlum or body-cavity and intervals in the walls of the oral cup or head. The retraction of the latter is produced by longitudinal muscles, which may be seen in the wall of the cup extending from the wall of the body just below the neck to the festooned membrane bordering the mouth.

The movements of the mouth with the partial extension and involution of the beak, together with the general movement of the animal, were strongly suggestive of those of the proboscis of an elephant.

The oral cavity converges in a funnel-like manner to a pouch occupying the neck. The pouch is seen to contract and expand from time to time, but it was indistinctly defined. At the bottom of the pouch there is a small mastax or muscular pharynx provided with minute jaws. These parts were but indistinctly seen, and indeed the jaws could be detected only after compressing the animal and examining it with the $\frac{1}{10}$ objective glass of the micro-

scope. The jaws are composed of a parallel series of about twenty teeth.

The body of the animal is fusiform or elliptical and narrows into a long tail, attached by the end. In contraction, the body and tail become more or less wrinkled transversely, as in *Megalotrocha*. The tail is occupied by retractor muscles extending from the walls of the body. The cavity of the latter is occupied by a capacious stomach, elliptical in shape and extending from the mastax to the root of the tail, but its mode of termination I did not detect. The anal aperture occupies a position near the latter, but its exact character I also failed to determine. The interval of the stomach and wall of the body is occupied by the ovaries and ova. In the vicinity of the lower extremity of the stomach there were several yellow spherical balls; a large one with concentric layers, and several small ones apparently of the same nature. The character of these I could not make out. An ovum was observed to be discharged in the vicinity of the anal aperture, but its outlet was not distinguished. The ova are large and oval, and exhibit no signs of segmentation at the time of extrusion.

The embryo, figs. 5, 6, developed in the egg exterior to the parent, at the time of its escape is a soft worm-like body, with a blunt head end and tapering behind to a rounded tail end in the dorsal view. The head end, not distinct from the body, is retractile; and the terminal mouth is furnished with vibratile cilia, which are also retractile. The posterior part of the body is indistinctly divided and is retractile in a telescopic manner. In the lateral view the tail end appears slightly notched or furcate, with one branch longer than the other. The head exhibits a pair of minute red eye-points, and a short distance behind, it presents a minute pointed papilla, with a still more minute bristle at the summit. The embryo swims and moves about very much in the manner of the common Rotifer, often adhering by the tail end, retracting head or tail and successively elongating.

The chief distinctive characters of the animal thus described are as follows:

Acyclus inquietus.

Body fusiform, tapering behind into a long narrow tail-like appendage, by which it is attached, not distinctly annulated, but becoming transversely wrinkled in contraction. A non-ciliated cup-like head prolonged into an incurved digitiform appendage

(as a substitute for the usual trochal disk), contractile and retractile.

Length of the animal from 1·2 to 1·5 mm.; breadth of body 0·15 to 0·21 mm. Length of head, with moderate extension of the digitiform appendage, 0·216 to 0·27 mm.; breadth, 0·15 to 0·18 mm. Ova, 0·1 to 0·133 long, by 0·06 to 0·09 mm. broad. Embryo, 0·36 mm. long by 0·06 wide at the head end.

With the figures of *Acyclus*, for comparison with this and other Rotifers devoid of trochal disks which have been described, I have given one, fig. 7, of *Dictyophora*, drawn from observation of the animal some years subsequent to its discovery. The creature was attached to objects in, and to the inner surface of, an aquarium and could not be examined advantageously; and I had deferred my investigation of the animal to a more favorable opportunity. Under the circumstances the drawing must be viewed as only approximately correct. As previously indicated, the original description of *Dictyophora vorax* occurs in these Proceedings for 1857. Since then I have had several opportunities of observing it, and it appears readily to be introduced and reproduced in an aquarium with water and aquatic plants from the rivers of our vicinity.

Dictyophora is oval or ovoid, with the narrower pole, corresponding with the position of the mouth, truncated, and it adheres by a small disk or sucker to one side of the broader pole. The animal has the power of turning on its point of attachment, but whether it has the power of detaching itself at any time I did not ascertain, though the same individual appeared after some days not to have changed its position.

The body is transparent, colorless, and even, and exhibits no signs of annulation, nor does it become transversely wrinkled by contraction. The external chitinous wall presents an appearance of scattered granules or minute tubercles. The interior exhibits the digestive apparatus and other organs, mostly more or less obscured by an accumulation of eggs in various stages of development.

From the truncated extremity of the body, the animal projects a capacious delicate membranous cup, forming more than half a sphere and more than half the size of the body. At will the cup is entirely withdrawn into the body and the orifice of this becomes contracted and puckered into folds radiating from a central point

or orifice. When protruded the cup expands outwardly like an opening umbrella, and when fully expanded equals the breadth of the body with more than half its depth. It is provided with an irregular reticulation of delicate muscles, mostly longitudinal and a few transverse, and scarcely distinguishable from wrinkles. Other muscles, acting as retractors, extend from the membranous cup to the inner wall of the body of the animal. The cup or net substitutes the ordinary trochal disks of Rotifers and appears as a most efficient means in catching the animalcules which serve as food to *Dictyophora*.

The prehensile cup opens into a capacious sac which is within the body and occupies a good portion of its upper half. The sac at bottom communicates with a mastax nearly central in position. This is provided with a pair of jaws each consisting of a larger tooth and a vertical series of four smaller ones. The jaws are observed to be in frequent motion, as usual in Rotifers.

The mastax opens into a capacious sacculated stomach of a brownish or yellowish color. The outlines of the different portions of the alimentary apparatus are difficult to make out from their being more or less obscured by the ova with embryos contiguous to them. Muscular fibres pass from the viscera to the outer wall of the cœlum, or body-cavity. Adherent to this wall there are situated at different points whitish bodies, similar to those seen in other animals of the class, the nature of which is unknown.

Numerous ova, in all conditions from the earliest to those which contain fully developed embryos, occupy the body-cavity of *Dictyophora*, sometimes in such numbers as to obscure everything else from view.

Various specimens of *Dictyophora* with extended cup measured from 0·6 to 1 mm. in length. Closed specimens from 0·35 to 0·6 mm. long by 0·28 to 0·5 mm. broad. Ordinarily the body measured from 0·45 to 0·6 mm. long by 0·35 to 0·5 mm. broad. The cup in several ranged from 0·26 to 0·5 mm. both in height and breadth.

The animal is exceedingly sensitive, and with the slightest disturbance withdraws its net. It feeds especially on smaller animalcules, and in one instance upwards of fifty of these were squeezed from the stomach.

From *Apsilus lentiformis*, which *Dictyophora* closely resembles,

it differs especially in the absence of the lateral antennæ, and the conspicuous ganglion of the cephalic cup.

While *Lindia*, *Taphrocampa* and *Balatro* may be open to the suspicion of possessing ciliary rotiform disks, which perhaps were concealed when the animals were observed, the same cannot be the case with *Dictyophora*, *Apsilus* and *Acyclus*.

As remarked by Mr. Forbes, the former name had been preoccupied; and thus if the *Cupelopagus* should prove to be the same, this name may properly supply its place.

REFERENCES TO PLATE II.

Figs. 1–6. *Acyclus inquietus.*

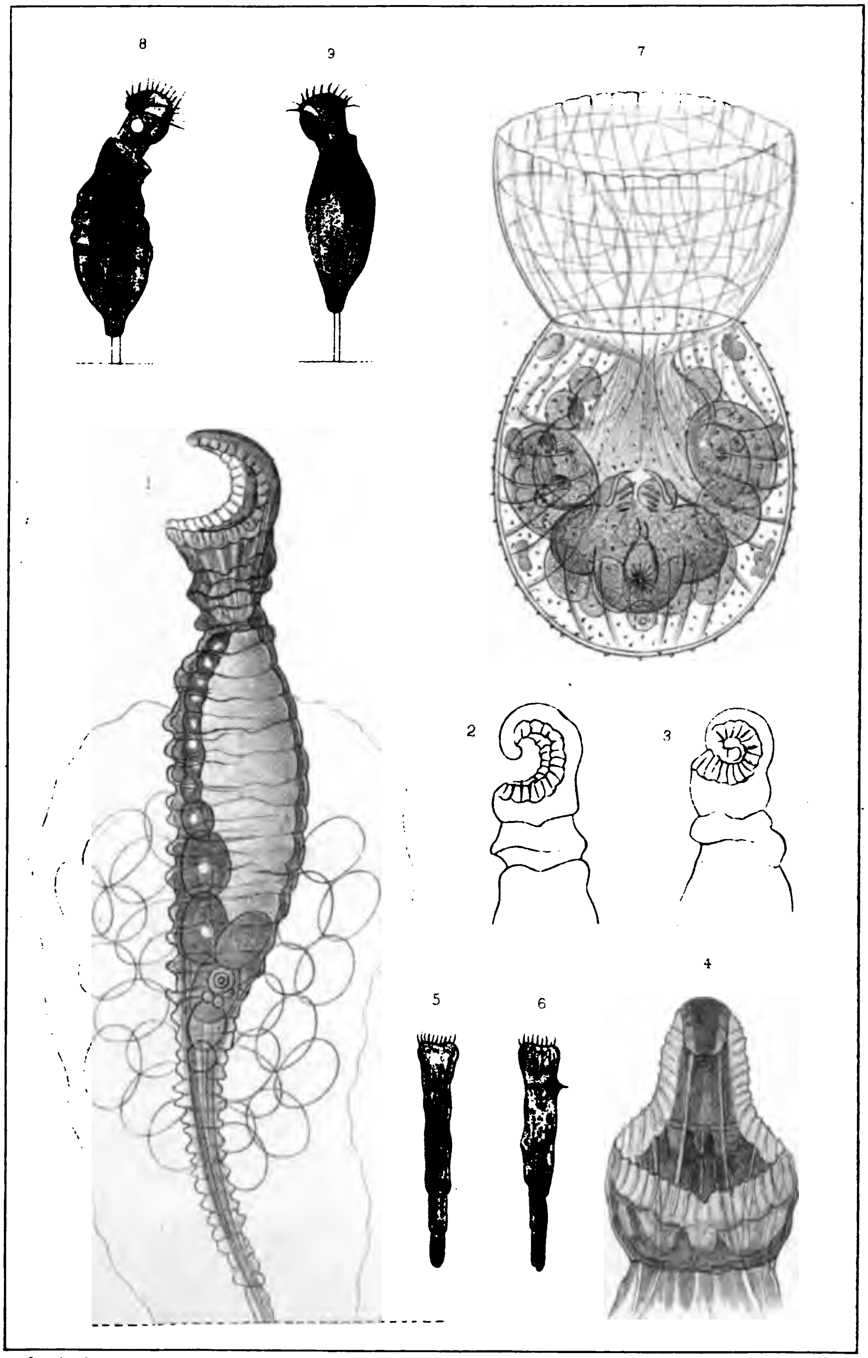
Fig. 1. The animal extended, enclosed with eggs, in a gelatinous sheath. Magnified 96 diameters.

Figs. 2, 3. Different degrees of contraction of the head-cup. Magnified 96 diameters.

Fig. 4. Anterior view of the head-cup. Magnified 166 diameters.

Figs. 5, 6. Front and side view of the embryo. Magnified 80 diameters.

Fig. 7. *Dictyophora vorax.* Animal with its head-cup extended. Magnified 75 diameters.



Jos. Leidy M.D. del.

1-6. ACYCLUS INQUIETUS. 7 DICTYOPHORA VORAX.
8-9 PYXICOLA ANNULATA.

OCTOBER 10.

The President, Dr. LEIDY, in the chair.

Twenty-three persons present.

A paper entitled "Snares of Orb-Weaving Spiders," by the Rev. Henry C. McCook, was presented for publication.

OCTOBER 17.

The President, Dr. LEIDY, in the chair.

Twenty-six persons present.

On the Mode of Entrance of the Sporidia of Parasitic Fungi.—Mr. THOMAS MEEHAN exhibited specimens of *Panicum sanguinale* L., the "Crab-grass" or "Fall-grass" of the Northern States, which were infested with a species of smut, according to Mr. Ellis allied to *Ustilago juncei*,[1] but which were of interest chiefly for the light they might throw on the still disputed question, whether the sporidia of the lower forms of fungi were introduced to the infested plant from the outside, or in some way through the circulatory system. There seemed to be some difficulties in the way of the belief that the introduction could be through the roots, and the spores find their way through the plant-structure to the surface—and yet there were some positive facts on record, which, unless controverted, showed, impossible as it might seem from a physiological and structural point of view, that there were good reasons for that belief. He referred to papers by Dr. E. Queckett, in the "Transactions of the Linnæan Society," especially the one published in vol. xix, p. 137, detailing experiments with potted plants of rye and other grains watered with water in which the sporidia of the ergot had been infused. The plants so watered in every case reproduced the ergot in the grain of the growing plants—and in no case did ergot appear in the plants which had ordinary water applied to them.

The case now exhibited tended to strengthen the observations of Queckett. Usually specimens of affected grass might be found where the herbage was growing in a mass, and a person could not tell whether the specimens were all from one plant or not. In this case the specimens of *Panicum* were all growing in a cultivated field, and in tufts distinct from one another. The plant from

[1] Since this communication was made, Mr. Ellis identified the fungus with *Ustilago Rabenhorstiana*.

which these specimens were gathered, was surrounded by others, the culms of these surrounding ones interlacing those of the plant exhibited, but only this one plant was infected. He did not count the number of culms, but felt safe in saying there were over fifty. In walking through this field among many hundreds of plants of this *Panicum*, he saw only one other plant, which in like manner was infested. This had one perfect panicle only among the numerous infested ones—the interlacing branches of surrounding plants of the same species being free, as in the other instance. It was scarcely credible that sporidia of the *Ustilago*, floating through the atmosphere, settled on fifty separate culms of one plant, and not one on the culms of adjacent plants which were growing in and among them. Again, the leaves of the *Panicum* have a large spathaceous sheath, two or three inches long. The *Ustilago* attacked the panicle while closely swathed in this sheath, and fully perfected its growth entirely therein. He had indeed to unfold the sheath in order to detect the mass of "smut" to which the embryonic panicle was reduced, in order to detect its presence. Only the peculiar appearance of the grassy tuft having no inflorescence as in the case of its neighbors, drew attention to the plant in the first instance. If it seemed incredible that fifty culms interlocked with as many from other plants, should each receive a germinating spore alone, it was still more incredible that the spores should have found their way from the outside to the interior of these tightly twisted sheaths.

These observations did not prove that the sporidia entered the plant by the roots, and made their way in some incomprehensible manner through the structure to the inflorescence; but they did render the external-entrance hypothesis doubtful, and, in connection with Queckett's experiments, are possibly of some worth.

Dr. LEIDY made some remarks on Mr. Meehan's communication, showing that the tendency of modern observations rather favored the view that the entrance of the sporidia of microscopic fungi was from the outside.

Sexual Characters in Cephalotaxus.—Mr. MEEHAN exhibited some fruit of *Cephalotaxus Fortunii*, a Chinese tree, this plant growing on the grounds of P. J. Berckmans, at Augusta, Georgia. This tree had for many years produced male flowers only. During 1882, it produced abundance of fruit. It showed that the genus was not truly diœcious, and further it afforded an illustration now not uncommon, that trees a long time of one sex only, would sometimes change to another. Sex is not an invariable characteristic in an individual tree.

A New Infusorian belonging to the Genus Pyxicola.—Prof. LEIDY exhibited drawings of an infusorian, a species of *Pyxicola*, which appeared to be different from those previously described.

It is of frequent occurrence, attached to the tubes of *Plumatella*, *Urnatella* and *Cordylophora*, on stones, in the Schuylkill River, below Fairmount dam. In shape it resembles *Pyxicola pusilla* and *P. affinis*, fresh-water forms of England, but is annulate as in *P. socialis*, a salt-water form. It is represented in figs. 8 and 9, Pl. II, and presents the following characters:—

PYXICOLA ANNULATA. Lorica urceolate, slightly curved, inflated towards the middle, tapering below, cylindrical and feebly contracted at the neck, and with the aperture oblique and circular; variably annulate, mostly at the neck, often at the middle; color chestnut-brown, but colorless when young; pedicle short, always colorless. The contained animalcule is of the usual shape; with an attached operculum, which is of the same color as the lorica, and is protruded beyond this when the animal is fully extended. Length of lorica, 0.52 to 0.792 mm.; breadth, 0.02 to 0.0264 mm.; length of pedicle, .004 to .008 mm.

The following was ordered to be printed:—

SNARES OF ORB-WEAVING SPIDERS.

By Rev. Henry C. McCook, D. D.

The characteristics upon which the true spiders should be classified into principal groups have not been agreed upon by araneologists. Without entering upon the discussion I have accepted the arrangement of Prof. Thorell of Upsala, which is substantially that of Latreille, and is based upon the spinning habits of the animal. That it is open to objection, can readily be shown; but on the whole it appears more satisfactory than any other. In accordance with this arrangement we have two great groups or divisions; *first*, the Sedentary Spiders, whose habit is to remain (for the most part) upon or in their web and capture their prey by means of snares; *second*, the Wandering Spiders, who hunt their food upon the ground, the water or trees. The first division is subdivided into sections according to the general character of the web; the second, according to the chief peculiarity of the spider's action or gait.

The following tabulated statement will present this arrangement:—

CLASS ARACHNIDA.

ORDER ARANEA.

I. *First Division.*

Sedentary Spiders.

Section 1. Orbitelariæ, Orb-weavers.
" 2. Retitelariæ, Line-weavers.
" 3. Tubitelariæ, Tube-weavers.
" 4. Territelariæ, Tunnel-weavers.

II. *Second Division.*

Wandering Spiders.

Section 5. Citigradæ,[1] Citigrades.
" 6. Laterigradæ, Laterigrades.
" 7. Saltigradæ, Saltigrades.

[1] Prof. Thorell assigns the Laterigrades to the 5th section, the Citigrades to the 6th. I have ventured to so far change this arrangement as to reverse the positions of the Laterigrades and Citigrades. The Citigrades appear to me to approach the Tubeweavers, both in structure and economy, more nearly than the Laterigrades. So also the step from the Citigrades to the Laterigrades though the genus *Dolomedes* appears more natural

This arrangement, based in the main upon the economy of the animal, will be found to harmonize closely with the classification into families, genera and species based upon structural characteristics.

I propose in this paper to apply this principle of arrangement according to economy to the first section of the Sedentary Spiders—the Orb-weavers. It should be understood that the classification proposed is simply tentative, and in its present form is incomplete. It is given with the hope that it may lead to something better by fixing the attention of the very few students of our spider-fauna, among whom no such grouping has hitherto been proposed. Moreover, it is hoped that the arrangement may have some interest to naturalists generally as bearing upon the correspondence between structure and economy and the value of habit as a factor in classification.

An orb-web may be defined as a series of right lines radiating from a common centre, and crossed at intervals by other right lines attached at the points of contact and covered by viscid beads. Orb-webs are divided generally into Vertical snares and Horizontal snares, according as they are perpendicular to, or parallel with, the plane of the horizon. The Vertical snares I have subdivided into (1) Full Orb, (2) Sectoral Orb, (3) Actinic Orb, (4) Orb Sector; the Horizontal Snares into (5) Plane Orb, (6) Domed Orb. I present the following table:—

ORB-WEAVERS' SNARES.

I. VERTICAL SNARES.

Snare spun vertically; spider hanging at the centre of the converged radii, or in a silken or silk-lined den.

1. Full Orbs.

Lines crossing all the radii spirally. (Forming complete circles.)

i. *Simple Snares.*—Simple orb of radiating straight lines and concentric circles.

a. The hub meshed. *Epeira insularis*, *E. strix.*[1]

b. The hub open; central space ribboned or tufted. *Acrosoma rugosa*, *A. spinea*, *A. mitrata*, *Gasteracantha cancer.*

than the reverse, as Thorell has it; and the step to the Saltigrades from the Laterigrades is quite as, if not more, natural than from the Citigrades. From the standpoint of economy alone the passage is certainly easier.

[1] These are representative species of a large group.

c. The central space ribboned, cocoons and debris attached to the ribbon. *Cyrtophora caudata.*

ii. *Compound Snares.*—Orb partly surrounded by an irregular mass of crossed lines.

a. Central space sheeted or ribboned; wings or guards of crossed lines. *Argiope riparia, A. fasciata.*

b. Hub meshed; mass of line-weaving above containing the spider's home and cocoons. *Epeira labyrinthea.*

2. Sectoral Orb.

Radii crossed by lines forming nearly complete circles.

i. *Simple Snares.*

a. Hub meshed (?); the beaded spirals divided into bands by an unbeaded line and space. *Nephila plumipes.*

ii. *Compound Snares.*

a. Hub meshed; tubular den or tent in the retitelarian web. *Epeira globosa. E. thaddeus.*[1]

3. Actinic Orb.

Snare composed of several rays or orb-sectors bound together into an orb.

i. *Simple Snares.*

a. Hub wanting; a large, irregular, open central space. The radii prolonged into a trap-line. *Epeira radiosa.*

4. Orb Sector.

Snare, a sector of an orb.

i. *Simple Snares.*

a. Sector composed of four radii converging upon a single trap-line; radii crossed by notched lines. *Hyptiotes cavata.*

II. HORIZONTAL SNARES.

Snare spun horizontally: spider usually hanging beneath.

5. Plane Orb.

Snare, a circular plane.

i. *Simple Snares.*

a. Hub open. *Tetragnatha extensa; T. grallator.*

b. Hub finely notched; central space ribboned. *Uloborus riparia.*

ii. *Compound Snares.*—A maze of crossed lines spun below the orb.

a. Hub open. *Epeira hortorum; E. gibberosa.*[1]

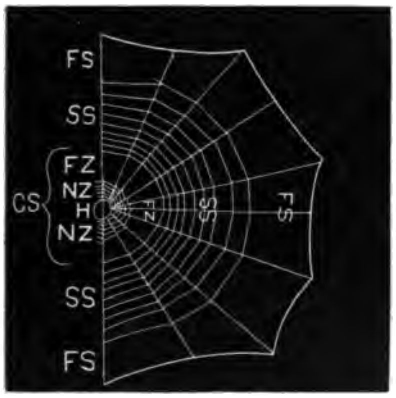
[1] The generic classification of Hentz is here retained.

6. Domed Orb.

Snare elevated into a dome by a pyramidal mass of crossed right lines.

i. Concentric lines all notched; spider hanging beneath the centre. *Epeira basilica.*

Several technical terms in this table, which I have been compelled to invent, require explanation. I have divided an orb-web into three parts. *First*, beginning at the outer margin, the Foundation Space, the open space between the foundation lines or frame, and the beaded spirals; *second*, the Spiral Space, that part covered by the spiral lines; *third*, the Central Space, the central circle enclosed by the spiral space. The central space is subdivided into three parts, first the hub, the small open or meshed circle upon which the radii meet; second, the Notched Zone, a series of unbeaded spirals lying next to the hub which do not cross the radii directly, but a little above the point of contact; and third, the Free Zone, a part free from crossed lines between the notched zone and the spiral space.



FS=Foundation space.
SS=Spiral space.
CS=Central space.
FZ=Free zone.
NZ=Notched zone.
H=Hub.

OCTOBER 24, 1882.

Mr. JACOB BINDER in the chair.

Eight persons present.

On the Habits of the Ant-Lion.—Rev. Dr. H. C. McCOOK remarked that, through the kindness of Mr. C. H. Baker, he had had an opportunity to observe closely some of the habits of the larva of *Myrmeleon obsoletus* Say. Several of these grubs had been taken from the sandy soil of New Jersey during the month of July, and brought to the Academy at Philadelphia in a large bowl. Their pits were of the usual character—an inverted hollow cone—but were sharper at the apex than usually represented. The pit is sometimes made by a backward movement of the grub upon a spiral line which gradually closes upon the centre. The body is just under the sand during this movement; and the grains of sand which fall upon the head are continually thrown upward by a sharp jerk of the head; this motion is somewhat lateral, not unlike the "butting" of a sheep or goat.

A pit is also formed by the grub while stationary, the violent ejection of the sand by the toss of the head, causing a vortex towards which the surrounding sand runs from all sides, thus naturally forming the concavity. Within this the creature lies concealed, and at once begins to toss the sand when the surface at the margin is agitated by a crawling insect. Sometimes the head and jaws are exposed; they are laid flat (as observed in these cases at least), extending horizontally and not vertically upward as is usually shown in figures. The habit may vary in this respect.

Dr. McCook believed that the popular impression that the grub throws sand after or at an ant when it appears to be escaping from the pit, is without foundation in fact. The sand is thrown up, more or less violently; so vigorously at times that it appears to boil. This motion causes agitation of the superincumbent sand, which begins to move toward the centre, carrying the ant with it into the jaws of the grub. The sand was tossed up with force enough to throw it out of the bowl to the distance of seven inches on the table, even pellets as large as grains of rice being thus ejected; but it flew in all directions, on the side opposite the ant, or upon the ant quite indiscriminately.

The smallest ants introduced had great difficulty in moving over the wall of the pit, as the sand crumbled and rolled away from beneath even the light emmet tread. One ant which escaped had a little ball of minute pellets attached to a hind foot, as though caused to adhere by moisture or some viscid substance within the pit. Others had minute grains adhering to the delicate

hairs of the body at many points. The inquiry was suggested whether there is any secretion or excretion from the grub which may produce this effect and so contribute to secure the victim.

The ants show a strange fascination for the pit, even after they have escaped. A large Carpenter ant (*Camponotus pennsylvanicus*) was seized, escaped, rushed out of the hole, then in and around it again and again, as though verily dazed. There is a vast deal of the "Paul Pry" in the emmet nature, but the ants were rarely observed to deliberately walk into the pit. They stopped upon the edge, when they reached it in course of their rambles about the bowl, threw up their antennæ and waved them restlessly, sometimes stretched a fore-foot over the brink, sometimes retreated, sometimes turned and began to circumambulate the pit. The agitation upon the sand, slight as it was, generally (not always) aroused the grub to action, and by the process already described, the sand was withdrawn from beneath the feet of the insect, who slid along with the tiny sand-avalanche into the apex. There it was seized unless, as sometimes occurred, it was fortunate enough to make its escape.

The use of the long hooked mandibles of the grub appeared in the act of seizure; the ants were held off "at arm's length," so to speak, and the grub thrashed or jerked them violently until they were exhausted. Meanwhile, the efforts at defense were made futile by the distance from any vital point at which the victim was held. *Tetramorium cœspitum*, the Pavement ant, which has a sharp sting, and tried eagerly to use it, was thus prevented from doing so and made quite defenseless. So also the formidable pincer mandibles of the Carpenter ant, by which she excavates her wooden galleries and decapitates her victims with the facility of a guillotine, are rendered entirely useless. This defenselessness is completed by the position of the grub beneath the sand. A Carpenter worker-minor seized by a hind leg bowed her body under to snap at her captor; but her jaws grasped only the gritty pellets of sand which covered the ant-lion's head and out of which the long hooks alone projected.

The point of greatest importance which Dr. McCook observed, was the confirmation of the statements of M. Bonet, concerning the behavior of the grub when its movements are obstructed by pebbles too large to be tossed out by the head. This statement having been seriously questioned,[1] the matter was tested by first dropping three pebbles, each larger and heavier than the larva within the centre of the pit. The grub having attempted to remove these in the usual manner, and failed, proceeded in this wise: It backed up to a pebble, and placed the posterior of the abdomen against, and a little beneath it, so that the sand readily dropped over the apex of the abdomen and lay between that and

[1] Rennie, Insect Architecture, p. 202. "We may be pardoned for pausing before giving full credence to these details."

the stone. A little adjustment was required to balance the pebble by getting its middle part against the end of the body, and then the animal began to back out of the pit, so pushing the pebble before, or rather behind it, up the side, and to a point a short way beyond the margin, where it was abandoned. A small furrow —two to three inches long—was described in the sand by the moving stone, which furrow was curved from the point of departure. The stone was kept perfectly balanced during the entire progress, which was quite rapid. Each of the three pebbles was thus removed, the grub returning each time and backing it out of the pit. The experiment was repeated a number of times and always with the same result. Some well-rounded stones were selected in order to make the difficulty of balancing greater, but this made no difference in the action of the larva, a round pebble being balanced and removed quite as readily as a flat one. It was a curious and amusing spectacle to witness the odd little creature thus backing the accurately poised impediments out of its domicile, and then returning to put its house in order once more. The correctness of the early observations of M. Bonet is thus fully confirmed by Dr. McCook's experiments.

October 31.

The President, Dr. Leidy, in the chair.

Thirty-six persons present.

The resignation of Dr. Chas. Schaeffer as Curator was received and accepted.

Actinosphærium Eichhornii.—Prof. Leidy remarked that he had noticed in an aquarium what appeared to be eggs, adherent to the edges of the leaves of *Vallisneria*, from the Schuylkill River. On examining the egg-like bodies with a lens, they were observed to be covered with delicate rays. On transferring some of the bodies to the field of the microscope, they proved to be giant specimens of the larger sun-animalcule, *Actinosphærium Eichhornii.* They measured from three-fourths to one millimetre in diameter, independent of the rays, which extended from one-fourth to half a millimetre more. One of the smaller individuals contained four water-fleas, Daphnias, a third of a millimetre long, and one of the larger contained six of these. The *Actinosphærium* appears to be tenacious of life; several specimens having been retained alive and in good condition for three days, in a drop of water in an animalcule cage. They had discharged the Daphnias, but retained their original size. One of oval form measured 1 mm. long by 0.75 mm. broad. The smaller ones measured 0.75 mm. in diameter. After another day they appeared in good condi-

ANTS AS BENEFICAL INSECTICIDES.

BY REV. DR. H. C. McCOOK.

Through the courtesy of Rev. H. Corbett, a missionary of the American Presbyterian Board, at Cheefoo, China, I received a copy of the "North-China Herald," of April 4, 1882, containing an article by Dr. Magowan, of Wenchow, on the "Utilization of Ants as Grub-Destroyers in China." From this paper I quote the following sentences:

"Accounts of the depredations of the coccids on the orange-trees of Florida, induce me to publish a brief account of the employment by the Chinese of ants as insecticides. In many parts of the province of Canton, where, says a Chinese writer, cereals cannot be profitably cultivated, the land is devoted to the cultivation of orange-trees, which, being subject to devastation from worms, require to be protected in a peculiar manner, that is, by importing ants from neighboring hills for the destruction of the dreaded parasite. The orangeries themselves supply ants which prey upon the enemy of the orange, but not in sufficient numbers; and resort is had to hill-people, who, throughout the summer and winter find the nests suspended from branches of bamboo and various trees. There are two varieties of ants, red and yellow, whose nests resemble cotton-bags. The 'orange-ant feeders' are provided with pig or goat bladders, which are baited inside with lard. The orifices of these they apply to the entrance of nests, when the ants enter the bags and become a marketable commodity at the orangeries. Orange-trees are colonized by depositing the ants on their upper branches, and to enable them to pass from tree to tree, all the trees of an orchard are connected by bamboo rods.

"Is the orange the only plant thus susceptible of protection from parasitic pests? Are these the only species of ants that are capable of utilization as insecticides? Indubitably not; and certainly entomologists and agriculturalists would do well to institute experiments with a view to further discovery in this line of research."

I propose to consider whether the suggestion here raised is entitled to serious attention by economic entomologists in the United States, as likely to lead to valuable practical results.

I. In the first place it might be asked, *Are the domicile habits of ants favorable?* Ants possessing the habit of the China emmets referred to by Dr. Magowan are comparatively rare, certainly not many are known to science. Mr. F. Smith, in his Catalogue of Hymenopterous Insects in the British Museum,[1] gives figures of several fibrous nests made by arboreal species of ants, *Crematogaster* (*Pachycondyla*) *montezumia*, from Mexico, *Polyrhachis textor*, from Malacca, *Formica gibbosa*, India, and *Crematogaster arboreus*, from Port Natal. One of these, it will be observed, is a North American species, the only one indeed of which I have any knowledge. An Australian species, *Crematogaster læviceps*,[2] builds a pensile nest somewhat in the fashion of our hornet, upon trees. It contains a labyrinth of curved galleries and cells centering upon the interior. *Formica bispinosa*, of Cayenne, forms a nest of cottony matter from the capsules of Bombax.[3] In Brazil, this species, the *Polyrhachis bispinosus*, is popularly known as the "Negro-head Ant," the globular nest, covered on the exterior with little projections, being suggestive of close wooly hair. Smith says that the material of which it forms its nest, furnishes an article of commerce used as tinder, for lighting cigars, etc.[4] *Myrmica kirbii*, an India species described by Lieut. Col. W. H. Sykes,[5] which is apparently a species of *Crematogaster*, makes a formicary in the branches of trees out of the droppings of cows. These it spreads in thin, flaky, overlapping folia, like shingles or tiles. A dome-like roof covers the summit in an unbroken sheet, like a skull-cap on a man's head. The interior consists of a multitude of irregular cells, formed of the same material as the exterior. The "Green Ant," *Œcophylla virescens*, builds an arboreal nest of dead leaves, from which it often drops down in bevies upon travelers, very much to their discomfort. The nest is about eight inches in diameter, and is made of a leaf-pulp—as the hornet's nest is of a pulp of wood-fibre—and is hung among the thickest foliage, being sustained not only by the branches, but by the leaves which are wrought into the nest, and in parts project from the outer wall. Mr. Foxcroft discovered an

[1] Part vi, Formicidæ, Plates I, II, XIV.

[2] Smith, Catal. Brit. Mus., vol. 15, Formicidæ, p. 138.

[3] Lubbock, 1882, "Ants, Bees and Wasps," p. 24.

[4] Trans. Entomol. Soc., Lond., Ser. iii, vol. i, p. 32, 1862.

[5] Trans. Entomol. Soc., Lond., *id.*, p. 101.

African species of *Œcophylla*, which, when disturbed, swarmed in excited legions upon the outside of their papery domicile, against which they pattered so vigorously, as they moved, that the observer thought the rain was falling upon the leaves above.[1]

These are all exotic species. and I know of no American (U. S.) arboreal ants except those, like the various species of *Camponotus*, for example—the Carpenter ant—that live within the excavated wood. Any protection to the fruit wrought by these would be neutralized by the injury done the tree itself. Certain species of ants have also been reported as dwelling in the hollow interior of the spines that grow upon some of our thorny trees, like those referred to by M. Ernest André in his admirable work now going through press.[2]

Mr. W. H. Patton has described an indigenous species, *Stenamma gallarum*, as inhabiting a gall upon a dead but unbroken stock of golden rod.[3]

Ants are indeed often seen in great numbers upon trees, and moving in columns up and down the trunk and along the branches; but such are engaged in seeking food from aphides, coccids, galls, etc., and usually have their domiciles elsewhere, for the most part underground.

Mr. Smith describes a species (*Pseudomyrma modesta*), collected in Panama, which nests in the spines of a species of Acacia. The spines are three inches long, and the entrance to the formicary is a small hole gnawed near the point. There are no cells within, and this is probably (as the similar cases alluded to may be), simply an example of "squatter sovereignty."[4]

We do have indigenous ants with the habit of constructing nests of leaf-pulp, in the manner of the China species, as for example *Atta fervens* Say, and *Atta septentrionalis* McCook, heretofore described in these Proceedings. *Atta fervens*,[5] the Leaf-cutting or Parasol ant strips the leaves of various trees, reduces them to pulp, and forms nests rudely resembling those of the hornet. These nests, however, are underground, and not upon trees. As I have seen them in Texas hanging to the roots of an immense

[1] Wood, "Homes without Hands," p. 270-3.

[2] "Species des Formicides d'Europe," p. 52.

[3] Amer. Naturalist, Feb., 1879, p. 126.

[4] Trans. Ento. Soc. London, vol. i, ser. 3, p. 33.

[5] Proceed. Acad. Nat. Sci. Philadelphia, 1879, p. 33.

live oak-tree, or built up from the floor, or attached to the roof of their large subterranean caves, they quite resembled the pensile nests of the tree-ants as described by various writers. *Atta septentrionalis*[1] is a New Jersey species, and builds out of the leaves of pine nests which are little models—almost toy-like in their minute mimicry—of the Texas species. These, too, are underground, and although they have the requisite ability as to nest-making, the problem of domesticating them in the tree-tops could hardly be solved, even by an economic entomologist. It may be concluded, therefore, that if a domicile in the trees, as with the China species, be a necessary condition, we have no indigenous species upon which to experiment, either to utilize or develop a habit that will make ants so highly beneficial as insecticides as to justify any dependence upon them as protectors of fruits.

II. In the second place we may ask: *Is the food-habit of ants favorable?* Undoubtedly ants are insectivorous, or carnivorous, rather. Their food-supply is largely drawn from insects yielding sweet excretions or secretions; from the nectar and sugary exudations of plants, from fruits, from the oils of nuts, seeds, etc. They are also largely scavengers. Dead insects and animals of all kinds, refuse of many sorts afford them nutrition, but they do not limit their insectivorous tastes to mere scavenger work: they also prey upon living insects. This is true of our indigenous ant-fauna, although we have no such wholesale insecticides as the famous Eciton or Driver ant of Africa and South America, whose raiding columns clear out every living insect within their broad sweep.[2] I have seen the Mound-making ants of the Alleghenies (*Formica exsectoïdes*) preying upon our native Termite or White ant, *Termes flavipes*,[3] when the nests of this insect had been uncovered by turning up stones upon the mountains in search of specimens. It was surprising to note how quickly the Formicas appeared on the scene, seeming to dart out from behind every blade of grass, stick and stone, and leaping into the galleries that threaded the flat pit of the stone, seized with avidity the soft white Termes and made off with their prey. These ants and many

[1] Proceed. Acad. Nat. Sci. Philada, 1880, p. 359.

[2] See a full account in Belt's "Naturalist in Nicaragua," p. 17, seq., and "Naturalist on the Amazons," vol. ii, p. 350.

[3] Proceed. Acad. Nat. Sci. Philada., 1879, p. 154.

others have been seen capturing flies,[1] even on the wing, and frequently bringing home to their nests various insects, still living or recently killed.

So also the Agricultural ants of Texas,[2] have been seen after a shower to break suddenly out of their formicary, scatter throughout the foliage and return with immense numbers of living insects beaten down by the hard rain.

Forel[3] says that throughout the bounds of an ant-city of *Formica exsecta*, in Switzerland, covering many acres, he was not able to discover any other species of ant except a few nests of *Tetramorium cœspitum*, who owed their exemption to their superior agility. This is true in some measure of the allied *F. exsectoïdes*, in our mountains and the New Jersey barrens. In addition, it may be stated that ants are veritable cannibals, destroying and feeding upon not only individuals of their own family, but those of their own species. In the same connection may be mentioned a custom of American Indians to put furs and blankets infested by insects near the mounds of the Occident ant, in order to have them cleaned out by the insectivorous emmets.[4] So far, therefore, as the mere food habit is concerned, it is favorable to the idea of utilizing certain species of ants as insecticides.

III. A *third* question may be raised, viz.: *Do our ants exhibit in nature any special insectivorous habits that would make them natural protectors of crops?* This question has been considered at some length by the Agricultural Department of the United States Government in the matter of the cotton crops. In a report on Ants, prepared at the request of that department,[5] the writer reviewed the testimony gathered from many and widely separated sections as to the friendly offices of ants in destroying the eggs and larva of the cotton-worm. My opinion then was that, on the whole, those offices would hardly have an important commercial value, although to a certain extent beneficial. Many of the practical observers from whom information was collected, spoke highly of the services of the ants, especially of one, "the Cotton

[1] Mound making Ants of the Alleghenies, p. 259.

[2] Agricultural Ants of Texas, p. 108.

[3] Les Fourmes de la Suisse, p. 207.

[4] Honey Ants of the Garden of the gods, and Occident Ants of the American Plains, p. 151.

[5] Comstock's Report upon Cotton Insects, 1879, p. 181, seq.

Ant," *Solenopsis xyloni* McCook. These ants were particularly effective against the eggs, but attacked the larva also. So good an observer as Mr. Trelease ventures the opinion that ants are probably among the most important enemies of the cotton-caterpillar. One observer went so far as to think that the ants would ultimately destroy the cotton-worm, should it prove to be indigenous rather than of foreign origin.

All the ants considered in the above-named report are mining ants, and would therefore not be available for such uses as the species of the Chinese orangeries. There appears to be no good reason, however, why they might not be useful on the orange-trees of Florida, to which State some of them are native. But it would be a necessary condition, I think, that the ants should exist in such vast numbers as to compel, under the stimulus of hunger, a thorough canvassing of every neighboring object that might shelter available prey. The value of the Chinese Orange ants appears to turn upon such conditions, viz.: their limitation to tree surfaces as a foraging field, and their vast numbers. In short, a limited supply of food and an immense demand for it, constrain the ants to the most diligent garnering and careful gleaning. On the whole there is little hope that these conditions can be met by artificial domestication of American ant fauna.

IV. *Would it be practicable to domesticate the Chinese species in America?* In answering this question I can venture no opinion as to whether it would repay orange-growers, but as a matter of experiment, merely, I think it might be practicable. Certainly some of our species are widely distributed, and probably imported. That universal pest of the housekeeper, the little red ant, *Monomorium pharaonis*, is probably a foreigner; at all events is a cosmopolite, being found in houses all over the world. Mr. Frederick Smith had reason to believe that it is a native of Brazil, whence it has been distributed in merchandise.[1] *Formica rufa*, of the Rocky Mountains, and *F. exsectoïdes*, of the Alleghenies, differ little from the European *F. rufa* and *F. exsecta*. *F. sanguinea*, the Red Slavemaker, is common to both continents, and our Shining Slavemaker, *Polyergus lucidus*, differs very little from the European *P. rufescens*. The Pavement ant, *Tetramorium cæspitum*, inhabits both hemispheres. *Pheidole megacephala*, which I have found in the neighborhood of Philadelphia,

[1] Trans. Ento. Soc., London, vol. i, 1862, p. 33.

is distributed throughout the tropical and sub-tropical regions of the entire world.[1]

In view of these facts, there is a probability, at least, that the tree-ants of China might be introduced and domesticated. Whether *such* "Chinese migration" would be encouraged by an American Congress might have to be considered! And perhaps it would require the patience and skill of the Chinese *men* to successfully domesticate Chinese *ants*—could that be done at all.

In the same connection it may be said that some of our indigenous species have a remarkable elasticity of organism by which they are adapted to the widely varying climatic and geographical conditions of our country. For example, both the Red and Shining Slavemakers which inhabit the Atlantic coast, I have found in the Garden of the gods, Colorado.[2] Several species of the Carpenter ants are distributed throughout our forests from Maine to California, notably *Camponotus pennsylvanicus*, which I have found not only in our Eastern mountains, but in sub-tropical Texas. Prof. Aug. Forel[3] has examined specimens from New Orleans, and California, as well as from China, Japan and Siberia. Throughout all these regions it has precisely the same habits as described by the writer.[4] *Formica fusca*, which so often appears as a domestic ally or "slave" of the kidnapping species, is widely distributed over our continent, and is substantially identical with the species of the same name found nearly everywhere in Europe.

On the other hand, some ants have well-marked geographical limits which have not yet been overcome by natural movements. The Occident ant (*Pogonomyrmex occidentalis*), I have traced[5] approximately within a range of 13° latitude, say from 45° N. to 32° N.; and of 21° longitude, that is, from Brookville, Kansas, to Reno, at the base of the Sierra Nevada, 1622 miles west of the

[1] Catalogue des Formicides d'Europe, by Forel & Emory. Mittheilungen der Schweiz. Entom. Gesellsch., Bd. 5, Heft 8. Schaffhausen, Alexander Gelser, 1879.

[2] McCook, "The Shining Slavemakers," Proceed. Acad. Nat. Sci., Phila., 1880, p. 376, seq.

[3] Forel, "Etudes Myrmécologiques En.," 1879. Bull. Soc. Vaud. Sc. Nat. xvi, 81, p. 858.

[4] Trans. American Entom. Soc., vol. v, 1874-76, p. 277, seq.

[5] McCook, "Honey and Occident Ants," p. 125.

Mississippi River. There appears to be no satisfactory reason (from a human standpoint) why these insects should not have pushed eastward much further; but some cause (quite satisfactory from an emmet standpoint) seems to have marked their bounds in the very midst of the great plains. So also the Cutting ants are—fortunately for the agriculturists—even more sharply limited to the southwest; and within the same geographical province, but with a little more elastic margin, to which the Honey ants (*Myrmecocystus melliger*) are confined. Not to multiply examples it thus appears that the question of importing and domesticating beneficial emmet insecticides is conditioned and may be prevented by the creatures' peculiar organism. The Chinese tree-ants are apparently natives of the South, the province of Canton, and it does not appear from Dr. Magowan's paper whether they have been also utilized in the northern provinces. Their domestication in our Southern States would, therefore, be favored by similar climatic conditions. Independent of such considerations, there are always natural checks and helps to the increase of insects, often of a nature so extremely complicated with other species of animal-life and the plant-world, either hostile or friendly, that experiment alone can positively determine such a result.

In answer to the question, "Could ants be transported so far with a view to trying the experiment?" I would say that I think the matter practicable. I brought several artificial colonies of Honey ants from Colorado to Philadelphia, carrying them in glass jars, feeding them a little water and sugar. These were kept during the fall and winter, but as the purpose was only to observe their habits, no effort was made to domesticate them. Large numbers of workers of the Agricultural ants were sent to me from Texas through the mails, arriving in good condition, and living throughout the winter. They were not permitted to live longer, as I did not consider myself at liberty to introduce, for other than mere experimental purposes, any insect that might possibly become injurious. Similar attempts to obtain colonies of the Cutting ants, all failed, these insects evidently not having the same vital power, at least for such conditions as a tin box and a mail-bag, as the agriculturals.

Shipments of ants from China I believe could be made, by placing workers, larvæ, eggs, and, if possible, a queen, in roomy boxes containing portions of their nests, perhaps also a little soil,

and covered with close wire-cloth. They should be fed, not too freely, with animal fats and sugar, and given water in a sponge, soaked cork, or cloth. With care there seems to be no reason why such artificial formicaries should not be safely transported from China.

In conclusion I wish to say that whatever benefits the ant may be led by domestication to confer upon man, she already is entitled to consideration as a valuable, if not valued, friend of the race. I have elsewhere shown[1] that ants fill an important place in the economy of Nature by contributing to the fertilization of the earth. In the paper referred to it appears from measurements of the amount of soil actually excavated, that insignificant in size as these insects are, the labors of countless hosts through many years are by no means insignificant in the shifting of the soil. They pulverize the ground and bring it in great quantities to the surface, thus making good topsoil for the growth of vegetation. In addition to this it is shown that the ants bring about the aëration of the soil, so needful for its productiveness. Moreover, the system of "pores" established by the galleries which everywhere perforate the ground, affords, on the one hand, free entrance for the rains into the earth, and on the other hand a series of tubes through which, by capillary attraction, the moisture may ascend to the roots of the plants. The last work of Dr. Charles Darwin[2] is devoted largely to similar habits on the part of the earth-worm; and in view of the interest which that subject has elicited, I venture to again call attention to the distinguished service wrought for the benefit of agriculture by the industrious ant. Even if that insect should not be as tractable for domestication as her Hymenopterous ally, the bee, and in spite of her occasional forays upon our cupboards and crops, the ant is worthy to stand at the head of insects beneficial to man.

N. B.—Since the above was in press I have observed that Dr. Forel, in his "Etudes Myrmécologiques" for 1879, speaks of a Mexican species of *Camponotus* (*C. senex*), in the collection of Saussure, as bearing a label inscribed "Nids de papier dans les branches"—Nests of paper in the branches. This and *Pachycondyla montezumia* make two known North American species of Tree-ants.

[1] Proc. Acad. Nat. Sciences, 1879, p. 158, seq.

[2] The Formation of Vegetable Mould through the Action of Earthworms, 1882.

A REVIEW OF SWAINSON'S GENERA OF FISHES.

BY JOSEPH SWAIN.

In the year 1839, William Swainson published a general scheme of the classification of Reptiles, Amphibians and Fishes,[1] in which all the accepted genera of these groups are defined and a list of typical, or illustrative species is appended. Many new generic names are here introduced, the consideration of which forms the object of the present paper. I give a list of the new generic names proposed for Fishes by Swainson, with their equivalence in modern nomenclature, as I understand them. The list of species referred by Swainson to each genus is here repeated verbatim, the species considered by me as the type of each group being indicated by an asterisk (*). The whole work is singularly worthless as a contribution to science, and of interest only from the fact that the law of priority requires the adoption of many of these names.

It may be observed that Swainson possessed a very limited knowledge of Fishes. His definitions are seldom apt and very often incorrect, and but a small proportion of his genera can be received into the system. Of these few, scarcely any retain their original definition.

All difficult questions, involved in this paper, have been referred to Prof. D. S. Jordan, and to whom I am also indebted for other valuable suggestions, and for the use of his library. I am likewise indebted to Prof. C. H. Gilbert for kindly aid.

Cromileptes,[2] p. 201 = **Epinephelus** Bloch (about 1790).

C. altivelis Sw. Cuv., pl. 35. myriaster Rüp. (nec Cuv.), i. pl. 27, f. 1. gigas,* Ib., pl. 33.

C. miniatus, Rüp. i, pl. 26, f. 3. fuscoguttatus, Ib. f. 3, hemistictos, Ib. f. 3.

[1] The Natural History of Fishes, Amphibians & Reptiles, or Monocardian animals. By William Swainson, F. R. & F. L. S. * * * In two volumes. Vol. II. London. Printed for Longman, Orme, Brown, Green & Longmans, Paternoster Row, and John Taylor, Upper Gower Street, 1839.

[2] The name *Cromileptes* has been lately revived by Dr. Bleeker (Sys. Perca. Revis. Pars 1 a, 11, 1875), in place of his own *Serranichthys*, the type of which is *altivelis*. As, however, this species does not agree with the

Cynichthys, p. 201 = **Plectorhynchus**[1] Lacépède (1800.)
C. flavo-purpuratus.* Frey, Atl. pl. 57, f. 2. Bennet, Ceyl. Fishes, pl. 19 (fig. 42 c).

Variola, p. 202 = **Variola** Sw. (1839).
V. longipinna* Sw. Rüp. i, pl. 26, f. 2 (*S. louti* Rüp.).

Elastoma, p. 202 = **Etelis**, C. & V. (1828).
E. oculatus* Sw. Cuv., pl. 32.

Uriphæton,[2] p. 202 = **Variola** Sw. (1839).
U. microleptes* Sw. (Serranus phæton, Cuv. pl. 34).

Rabdophorus, p. 211 = **Chætodon** L. (1758), subg. **Rabdophorus** Sw.
Ephippium* Sw. Cuv. pl. 174.

Genicanthus, p. 212 = **Holacanthus** Lac. (1803).
Lamarckii,* Cuv. pl. 184. tricolor, Bloch, pl. 426.

Microcanthus, p. 215 = **Chætodon**, L. (1758).
G. strigatus,* Cuv. pl. 170.

Microgaster, p. 216 = **Etroplus** C. & V. 1830 .
maculata,* Cuv. pl. 136.

Chrysiptera, p. 216 = **Glyphidodon**, Lacépède (1802).
azurea,* Frey, Atl. pl. 64, fig. 3. Gamardii, Ib., fig. 4.

Chætolabrus, p. 216 = **Etroplus**, C. & V. (1830).
Suratensis,* Bloch., 217. maculatus, Ib., 427.

Chrysoblephus, p. 221 = **Sparus**, L. (1758.)
C. gibbiceps,* Cuv. pl. 147.

Argyrops, p. 221 = **Sparus**. L. (1758).
Spinifer,* Forsk. Russ. pl. 101.

Calamus, p. 221 = **Calamus** Sw. (1839).
E. megacephalus,* Sw. Cuv., pl. 152.

Lithognathus, p. 222 = **Lithognathus** Sw. (1839).
L. capensis,* Sw. Cuv., pl. 151.

Nemipterus, p. 223 = **Dentex** Cuv. (1817).
N. filamentosus,* Cuv., pl. 155.

diagnosis (not having a strong canine tooth on each side of lower jaw), and the other five species, which do so agree, belong to the prior genera *Epinephelus* and *Bodianus*, we should consider *Cromileptes* a synonym of *Epinephelus*.

[1] *Diagramma* Cuv., 1817.

[2] *Phæthonichthys* Bleeker. As has been shown by Dr. Vaillant, the *Serranus phæton* Cuv. and Val. was a made-up specimen, with the tail of a *Fistularia* skilfully fastened to the body of a Serranoid (probably a species of *Variola*).

Thalassoma, p. 224 = **Thalassoma** Sw. (= **Julis** Auct. *nec* **typus**).
T. purpurea,* Nob. Rüpp., Atl. pl. 6, fig. 1.

Urichthys, p. 224 = **Chilinus** Lac., (1802).
U. lunulatus,* Nob. Rüpp., Atl. pl. 6, fig. 1.
quinque-cinctus, Ib., ii, pl. 5, fig. 1.

Crassilabrus, p. 225 = **Chilinus** Lac., (1802).
C. undulatus,* Rüpp., Atl. pl. 6, fig. 2.

Leptoscarus, p. 226 = **Calliodon** Gronov. (1801).
L. vargiensis,* Quoy and Gaim, p. 288.

Hemistoma, p. 226 = **Scarus** Forskæl,[1] 1775.
H. reticulata, Sw. (Scarus pepo* Benn. Ceylon, pl. 28).

Petronason, p. 226 = **Scarus**.
P. psittacus*, Rüpp. pl. 20, 1.
Rüppellii, Ib., pl. 21, 1.
bicolor, Ib., pl. 21, 3.
longicauda, Ib., pl. 21, 2.
viridis, Bl., pl. 222.
flammiceps Bennett, Ceylon, Fish, pl. 24.
niger Rüpp. Atl. ii, pl. 8, 1.
collana, Ib., fig. 2.
pulchellus, Ib., fig. 3.

Erychthys, p. 226 = **Calliodon** Bloch and Schneider (1801).
E. croicensis,* Bl., pl. 221.
quinque-fasciatus, Benn. Ceylon, pl. 23, (fig. 60).
viridescens, Rüpp., ii, 7, fig. 2.
cæruleo-punctatus, Ib., 3.

Chlorurus, p. 227 = **Scarus** Forskæl (1775).
C. gibbus, Rüpp., Atl. pl. 20, fig. 2.

Sparisoma, p. 227 = **Scarus** Forskæl, subg. **Sparisoma**[2] Swainson.
S. Abildgardii,* Bloch, pl. 259.

Amphiscarus, p. 227 = ? **Teuthis** L. (1766).
A. fuscus,* Griff., Cuv., pl. 35.

Hemiulis, p. 228 = **Chilio** Lac. (1802).
H. vittatus, Griff., Cuv., pl. 6, 1.
guttatus, Bloch, pl. 357, 1.
auratus,* Frey, Atl. pl. 54, 2.
melapterus, Bloch, pl. 296, 2.

Cynædus,[3] p. 229 = **Cynædus** Sw. (1839).
C. Tinca,* Yarr., i, 293.
cornubicus, Ib., 296.
gibbus, Ib., 298.
luscus, Ib., 300.
rupestris, Bloch, pl. 250, fig. 1.
virens? Ib., 251, fig. 2.
notatus, Ib., 251, fig. 2.

[1] = *Pseudoscarus* Bleeker, 1861.

[2] = *Scarus* Bleeker.

[3] = *Crenilabrus* (not of Cuvier). Swainson observes: "M. Cuvier having expressly stated that the type of his genus *Crenilabrus* is the *Lutianus verres* of Bloch, I have so retained it, placing all the others, * * under the subgenus *Cynædus*." If this statement (which I am unable to verify) is correct, *Cynædus* Sw. must supersede *Crenilabrus*, which becomes a synonym of *Harpe*, Lac.

Astronotus,[1] p. 229 = **Astronotus** Sw. (1839).
A. ocellatus,* Spix, pl. 68.

Thalliurus,[2] p. 230 = **Thalliurus** Sw. (1839).
C. Blochii,* Bloch, pl. 260 (pl. ? 290).

Labristoma,[3] p. 230 = **Pseudochromis** Rüpp. (1835).
L. olivacea,* Rüpp., ii, pl. 2, fig. 3. flavivertex, ii, pl. 2, fig. 4.

Cichlasoma,[4] p. 230 = **Cichlasoma** Sw. (1839).
Labrus punctata,* Bloch, pl. 295, fig. 1.

Eupemis, p. 232 = **Chilio** Lac. (1802).
E. fusiformis,* Sw., Rüpp., Atl. ii, pl. 1, fig. 4.

Chloriothys,[5] p. 232 = **Thalassoma** Sw. (1839).
bifasciatus,* Bl., pl. 283.
ornatus, Ib., pl. 280.
Braziliensis, Ib., pl. 280.
lunaris, Ib., pl. 281.
cæruleocephalus, Frey., Atl. pl. 56, fig. 2.
Grayii, Sw., Ind. Zool., ii, pl. 92, 1.
Hardwickii, Benn., pl. 12.
quadricolor, Less., Atl. pl. 32, 1.
semicæruleus, Rüpp., Atl. ii, pl. 3, fig. 1.
aygula, Rüpp., Atl. i, pl. 6, 2.

Icthycallus,[5] p. 232 = **Coris** Lac. (1800).
dimidiatus, Spix, pl. 53.
chloropterus, Bl., pl. 288.
trimaculatus, Griff., pl. 45, fig. 2.
decussatus, Benn., pl. 14.
auromaculatus, Ib., 20.
semidecorata, Less., Atl. pl. 35, fig. 2.
geoffroyii, Frey., Atl. pl. 56, fig. 3.
umbrostygma, Rüpp., Atl. ii, pl. 3, fig. 2.
semipunctatus,* Ib., pl. 3, fig. 3.
cyanocephalus, Ib., pl. 286.
julis, Ib., pl. 287, fig. 1.
bivittatus, Ib., pl. 284, fig. 1.
macrolepidatus, Ib., fig. 2.
ornatus, Linn., Tr. xii, pl. 27.

Zyphothyca, p. 239 = **Gempylus** Cuv. (1829).
Z. coluber * Sw. Cuv. and Val., pl. 221.

Zanclurus, p. 239 = **Histiophorus** Lac. (1802).
Z. indicus* Nob. Cuv. and Val., pl. 229. Bloch, 343.

Polycanthus, p. 242 = **Spinachia** Fleming (1828).
P. spinachia * Sw. Yarrell, i, 87. Bloch, pl. 53, fig. 1.

[1] = *Hygrogonus,* Günther, 1862.

[2] = *Hemigymnus,* Günther, 1862.

[3] "The name of *Pseudo*-chromis is so objectionable, that I hope the learned naturalist who proposed it, will excuse me for offering another." (*Swainson.*)

[4] = *Acara,* Heck, 1840 (in part).

[5] *Chlorichthys* and *Icthycallus,* confused jumbles of species, may well be disposed of as synonyms of *Thalassoma* and *Coris*, respectively, although several other genera are represented in each.

Leiurus, p. 242 = **Gasterosteus** L. (1758).
aculeatus.* Yarr. i, 81. brachycentrus. Yarr. i, 82.
spinulosus. Ib. i, 83. pungitius. Ib. i, 85.

Chirostoma, p. 243 = **Menidia** Bonaparte (1836), subg. **Chirostoma**[1] Sw. (1839).
A. Humboldtiana.* Cuv. and Val., pl. 306,* (fig. 67).

Meladerma, p. 243 = **Elacate** Cuv. (1829).
M. nigerrima.* Russ., pl. 153. (Pedda. mottah.).

Platylepes, p. 247 = **Lactarius** Cuv. (1833).
P. lactaria.* Cuv., pl. 261.

Argylepes, p. 247 = ?
A. Indica. Russ., pl. 156. (Mitta Parah.).

Trachinus,[2] p. 247 = **Trachurus** Raf. (1810).
Alepes, p. 248 = ?
A. melanoptera* Sw. Russel, pl. 155. (Evori Parah.).

Zoniohthys, p. 248 = **Seriola** Cuv. (1829), subg. **Zoniohthys** Sw. (1839).
Z. fasciatus.* Bloch, pl. 341.
subcarinata. Russ., pl. 149.

Hamiltonia, p. 250 = **Hamiltonia** Sw., 1839 (= **Bogoda** Bleck.).
H. ovata.* Sw. Ham., fig. 37.
lata. Sw. Ib., fig. 37.

Platysomus, p. 250 = **Caranx** Lac. (1802), subg. **Vomer** Cuv. (1817).
Brownii.* Cuv., pl. 256.
Micropteryx *Sw.* App.
Spixii *Sw.* Spix., pl. 57.

Ctenodon, p. 255 = **Acanthurus** Forsk. (1775).
C. Rüppelii* Sw. Rüpp. 16 (fig. 74).
rubropunctatus. Rüpp. 15, 1.
lineatus *Sw.* Benn., pl. 2.
Cuvierii. C. V., pl. 289.
erythromelas. Less. Atl. 27, 1.
fuliginosus. Lesson 27, 2.

Zebrasoma, p. 256 = **Acanthurus** Forsk. (1775).
velifer* Sw. Rüpp. Atlas, pl. 15, fig. 2. Bl., pl. 427.

Callicanthus, p. 256 = **Monoceros** Bl. & Schn. (1801).
C. elegans.* (Aspisurus elegans.) Rüpp. Atl. 16, fig. 2 (fig. 75).

Xiphichthys, p. 259 = **Trichiurus** L. (1766).
Z. Russelii* Sw. Russ. i, p. 40 (p. ? 41).

Xiphasia,[3] p. 259 = **Xiphasia** Sw.
Z. setifer* Sw. Russ., pl. 39.

[1] = *Heterognathus*, Girard, 1854.
[2] Evidently a misprint for *Trachurus*.
[3] = *Nemophis*, Kaup., 1858; = *Xiphogadus*, Günther, 1862.

Ornichthys, p. 262 = **Prionotus** Lac. (1802), subg. **Ornichthys** Sw. (1839).
Carolinensis (Carolinus). Bl. 352.
punctatus* Ib., pl. 353.

Macrochyrus, p. 264 = **Pterois** Cuv. (1817).
miles.* Benn. Ceyl., pl. 9.

Pteroleptus, p. 264 = **Pterois** Cuv. (1817).
P. longicauda.* Russ. ii, pl. 133.

Pteropterus, p. 264 = **Pterois** Cuv. (1817).
T. radiatus.* Cuv. and Val.

Brachyrus, p. 264 = **Pterois** Cuv. (1817).
zebra.* Cuv. iv, p. 367.
brachypterus, Ib. iv, p. 368.

Pterichthys, p. 265 = **Apistus** Cuv. (1829).
P. carinatus.* Cuv. iv., p. 395. Israelitorum Cuv., iv, p. 396.
alatus. Russ. No. 160, B.

Platypterus,[1] p. 265 = **Tetraroge** Günther. (1860).
tænianotus.* Cuv. Lac. iv., pl. 3, fig. 2. longispinis. Ib. iv, 408.
Bourgomvillii. Ib. iv, 411. fusco-virens. Ib. iv, 409.

Trichosomus,[2] p. 265, = **Prosopodasys** Cant. (1850).
trachinoides.* Cuv. pl. 92, 1.
dracæna. Cuv. iv. p. 403.

Gymnapistes,[3] p. 265 = **Gymnapistes** Sw. (1839).
marmoratus,* Griff. Cuv., pl. 22, fig. 3.
australis, White's Voy., pl. 52, fig. 1.
Belangerii Cuv., iv., p. 412.
barbatus, Ib, 413.
niger, Ib, 415.

Bufichthys,[4] p. 268 = **Synancia** Bl. & Schn. (1801).
horrida.* Lac. ii, pl. 17 2.
grossa. Gray. In. Zool., i, pl. 97.

Trachicephalus,[5] p. 268 = **Polycaulus** Günther. (1860).
elongatus* Griff. Cuv., pl. 8, f. 3.

[1] Preoccupied by several genera.

[2] Preoccupied by *Trichosoma* Rud. Verm., 1819.

[3] = *Pentaroge* Günther, 1860. (See Bleeker, Mem. Scorpen, 7, 1876). As founded by Swainson, *Gymnapistes* contains species of *Pentaroge*, *Centropogon*, *Tetraroge* and *Prosopadasys*, all genera posterior to Swainson. *Gymnapistes*, may therefore, be properly substituted for *Pentaroge*.

[4] = *Synancidium*, Müller, 1843.

[5] Preoccupied by *Trachycephalus* Tsch. 1838 (a genus of Reptiles).

Ichthyscopus, p. 269 — **Ichthyoscopus**[1] Sw. (1839.)
U. inermis.* Cuv. iii, pl. 65.
Fosteri, Ib. 318.
cirrhosus. Cuv., Ib. 314.
lævis. Ib. 319.

Enophrys, p. 271 = **Enophrys**[2] Sw. (1839).
E. claviger,* Cuv. and Val., pl. 79, fig. 2.

Gymnocanthus, p. 271 = **Gymnacanthus**[3] Sw. (1839).
G. ventralis.* Cuv. and Val., iv, pl. 79, fig. 1.

Hippocephalus,[4] p. 272 = **Hippocephalus** Sw. (1839).
superciliosus* Pall. Sp. Zool. vii, pl. 5.
decagonus Schn., pl. 27. quadricornus. Cuv. pl. 80.

Canthirynchus, p. 272 = **Aspidophoroides** Lac. (1802).
C. monopterygius,* Cuv. and Val., pl. 169.

Blenitrachus,[5] p. 274 = 0.

Erpicthys, p. 275 = **Salarias**, Cuv. (1817). subg. ? **Erpicthys** Sw. (1839).
Atlanticus, Cuv., ix, 322.
quadripinnis,* Rüpp., 28, 2.
Sebæ, Ib., p. 323.
castaneus, Ib., 324.
fasciatus, Ib., 324.
cyclops, Ib., 32.
niger, Cuv., xi.
frontalis, Ib., 328.
ruficauda, Ib., 328.
quadricornis, Ib., 329.
variolatus ? Ib., 346.
frænatus, Ib., 342.

Rupiscartes, p. 275 = **Salarias** Cuv. (1817).
R. alticus,* C. V. xi, 337.

Cirripectes, p. 275 = **Salarias** Cuv. (1817).
C. variolosus,* C. V., xi, 317.

Chirolophis, p. 275 = **Chirolophus**[6] Sw. (1839).
C. yarrellii,* C. V., xi, 218.

Clinetrachus, p. 276 = **Clinus** Cuv. (1817).
superciliosus,* Bl., pl 168. perspicillatus, C. V., xi, 372.

Blennophis, p. 276 = **Clinus**[7] Cuv. (1817), subg. **Blennophis** Sw. (1839).
anguillaris,* (Clinus, do. C. V., xi, 390).
variabilis, Raff. (1810). (Clinus argentatus, C. V., xi, 354.)

[1] = *Anema* Günther, 1860, as restricted by Gill, Proc. Ac. Nat. Sci., Phila., 1861, 114.

[2] = *Aspicottus* Grd. (1854) = *Elaphocottus* Sauvage.

[3] = *Phobetor* Kröyer, 1844.

[4] Restricted by Gill, Proc. Ac. Nat. Sci., Phila., 1861, pp. 167, 259.

[5] No species mentioned, and apparently none known at the time.

[6] = *Blenniops* Nilsson, 1855 ; altered to *Carelophus* by Kröyer.

[7] Not *Blennophis* Val. of later date (about 1840) = *Ophioblennius*, Gill, 1860.

Labrisomus, p. 277 — **Clinus** Cuv. (1817), subg. **Labrisomus** Sw. (1839).
L. gobio, C. V., xi, 395.
pectinifer,* Ib., 374.
capillatus, Ib., 377.
Delalandii, Ib., 378.
linearis, Ib., 371.
variolosus, Ib., 381.
Peruvianus, C. V., xi, 383.
microcirrhis, Ib., 384.
? geniguttatus, Ib., 86.
elegans, Ib., 388.
? littoreus, Ib., 389.
latipennis, Ib., 394.

Ophisomus,[1] p. 277 = **Murænoides** Lac. (1800).
O. gunnellus,* (Blennius gunnellus, Linn.), Yarrell, i, 239.

Ogrichodes, p. 278 = **Gobioides**, Lac. (1800).
G. Broussonetii,* Griff., Cuv., pl. 38, fig. 2.

Scartelaos, p. 279 = **Scartelaus**[2] Sw. (1839).
Sc. viridis.* Ham., pl. 32, fig. 12.
crysophthalmus. Ib., pl. 37, fig. 10.
calliurus. Ib., pl. 5, fig. 10.

Rupellia, p. 281 = **Gobius** L. (1758).
R. echinocephala.* Rüpp. Atl., i, pl. 34, fig. 3.

Amphichthys, p. 282 = **Batrachus** L. (1758).
rubigenes.* Sw. Appendix.

Salmophasia, p. 284 = **Chela** Buch. (1822).
oblonga. Sw. Ham., fig. 76. (Cyp. bacaila *).
elongata. Gray, Ind. Zool. (Cyp. cora.).

Chedrus, p. 285 = **Chedrus** Sw. (1839).
C. Grayii * Sw. Gray, Ind. Zool., pl. 2, f. 3.

Esomus, p. 285 = **Esomus** Sw. (= **Nuria** C. & V. ? 1842).
E. vittatus.* Sw. Ham., f. 88. (Daurua).

Clupisudis, p. 286 = **Clupisudis** Sw. (= **Heterotis** Ehrenberg, 1843).
C. niloticus.* Rüpp., Fish of the Nile, i, pl. 3, f. 2.

Laurida ("Aristotle"), p. 287 = **Synodus** Gronov. (1801).
L. Mediterranea *Sw.* (*Vol.* 1, *p.* 246, *fig.* 48).
fœtans.* Bl. 384, f. 2.
tumbel. Ib., 430.
truncata. Spix, pl. 45.
semifasciata. Bl. 384, f. 1.
conirostra. Spix, pl. 43.
intermedia. Ib., 44.
minuta Le Sueur. (Vol. 1, p. 247, *fig.* 50).

Triurus,[3] p. 288 = **Saurida** Val. (1849).
T. microcephalus.* Russell, pl. 171.

[1] = *Gunnellus* C. & V. (1817), rejected because of barbarous origin.

[2] = *Boleops* Gill (1863), *fide* Bleeker, Esq. Syst. Nat. Gobioides, 40, 1874.

[3] Preoccupied by *Triurus* Lacép. 1800.

Mormyrnynohus, p. 291 = **Sohizodon** Agass. (1829).
M. Gronoveii * Sw. Gronov. Zooph., pl. 7, f. 2.

Trichosoma,[1] p. 292 = **Thrissa** Cuv. (1817).
Tr. Hamiltonii.* Gray, Ind. Zool., i, pl. 85, f. 3.

Setipinna, p. 292 = **Setipinna** Sw. (1839).
truncata Ham., p. 241, f. 72. megalura Sw., Ib., p. 240. (*Cl. phasa.**)

Platygaster,[2] p. 294 = **Pellona** Cuv. (1817).
Pl. Africanus.* Bl. 407.
megalopterus, Russ., pl. 191.
affinis, Gray, Ind. Zool.
parva, Gray, Ind. Zool., ii. pl. f. 3.
Indicus, Russ., pl. 192.

Cypsilurus, p. 296 = **Cypselurus** Sw. (1839).
C. Nuttalii * Le Sueur. Am. Tr. ii, pl. 4, fig. 1.
appendiculatus. Wood. Ib., iv, p. 283.

Leptodes, p. 298 = **Chauliodus** Bl. Schn. (1801).
L. sloanii.* Sch., pl. 85. L. Siculus. Sw. App.

Tilesia, p. 300 = **Gadus** L. (1758), subg. **Tilesia** Sw. (1839).
T. gracilis.* Til. Piscium, i, tab. 18.

Lepidion,[3] p. 300 = **Halopo-phyrus** Günther (1862).
L. rubescens * (Gadus lepidion Risso), xi, fig. 40, p. 118.

Cephus, p. 300 = **Gadus** Linn. (1758).
C. macrocephalus.* Til. Pisc., i, tab. 19.

Psetta,[4] p. 302 = **Bothus** Raf. (1810) subg. **Psetta** Sw.
P. maximus* Bloch, pl. 49.

Platophrys, p. 302 = **Platophrys**[5] Sw (1839).
P. ocellatus,* Spix and Agassiz, pl. 46.

[1] Preoccupied by *Trichosomus* Sw., p. 265, as well as *Trichosomus* Rud. Verm., 1817.

[2] Preoccupied by *Platygaster* Latr., Hym., 1809.

[3] Preoccupied by *Lepidea* Sav., Verm., 1817.

[4] The generic names *Bothus*, Raf. (1810), *Scophthalmus*, Raf. (1810), and *Rhombus*, Cuvier (1817, not of Lac. 1802), were alike based on *Pleuronectes rhombus*, L., and *Pl. maximus*, L., in all cases more particularly on the former, which may be taken as the type of each. If the *Pl. maximus*, be distinguished as the type of a genus or subgenus, it may stand as *Psetta*, Sw. *Lophopsetta*, Gill, is strictly synonymous with *Bothus*, its type being extremely closely allied to *Bothus rhombus*.

[5] = *Rhomboidichthys* Bleeker (1856).

Brachirus, p. 303 = **Euryglossa**[1] Kamp.
plagiusa, Linn.
orientalis,* Sch., 157.
zebra, Bloch, pl. 187.
Commersoni, Russ., No. 70.
jerreus, Russ., No. 71.
Pan, Hamil., pl. 14, fig. 42.

Hoplisoma, p. 304 = **Corydoras** Lac. (1803).
H. punctata,* Bloch, 377, fig. 2.

Sturisoma, p. 304 = **Loricaria** L. (1766), subg. **Sturisoma**, Sw.
S. rostrata,* Spix and Agassiz, pl. 3.

Felichthys,[2] p. 305 = **Felichthys** Sw. (1839).
F. filamentosus, Bl., pl. 365.
nodosus,* Bl. 368, fig. 1.

Cyclopium, p. 305 = **Cyclopium**[3] Sw. (1839).
C. humboldtii, Sw. (Pimelodus cyclopium,* *Auct.*)

Silonia[4] p. 305 = **Silondia** Sw. (1839).
S. lurida,* Ham., p. 160, 7, fig. 50.
diaphina, Ib., p. 162.

Pachypterus,[5] p. 306 = **Pseudeutropius** Blkr. (1863).
P. Atherinoides,* Bl. 371, f. 1.
luridus, Ham., p. 163, f. 62.
trifasciatus, Ib., p. 180, f. 59.
punctatus, Ham., p. 196, f. 64.
melanurus, Ib., (*Murius*, Ham), p. 195.

Clupisoma, p. 306 = **Clupisoma**[6] Sw. (1839).
C. argenata,* Ham., 156, pl. 21, fig. 50.

Pusichthys, p. 307 = **Schilbe** Cuv. (1817).
P. uranoscopus,* Rüpp., Egypt., pl. 1, fig. 1, *a*, *b*.

Cotylephorus, p. 308 = **Aspredo**[7] L. (1758).
C. Blochii,* Sw. (Platys. cotylephorus, Bl. 372).

Pteronotus, p. 309 = **Pimelodus** Lac. (1803).
P. 5–tentaculatus,* Sp. and Agassiz, pl. 11.

Acoura, p. 310 = **Nemachilus** Von Hasselt. (1823).
C. obscura,* Hamilt., p. 357.
No. 9 (aberrant).
argentata, Ib., 358, No. 10.
cinerea, Ib., 359, No. 12.

[1] = *Euryglossa*, Kamp.; *plagiusa*, the first species mentioned, does not agree with the diagnosis, not having "*two* pectoral fins." *Brachirus* is preoccupied by *Brachyrus*, Swainson, both names being abridgments of *Brachychirus*.

[2] = *Auchenipterus*, Cuv. 1840.

[3] = *Stygogenes*, Gthr. (1864).

[4] Misprint for *Silondia* = (*Silundia*, C. & V., 1840).

[5] Preoccupied by *Pachypterus*, Sol., Col. 1833.

[6] = *Schilbeichthys*, Bleeker, 1858.

[7] = *Platystacus*, Bloch, 1801.

Canthophrys, p. 310 = **Botia** Gray (1831).
C. albescens,* Ham., Cob. No. 3. olivaceus, Ib., No. 8.
rubiginosus, Ib., No. 6. vittatus, Ib., No. 4 (aberr.).

Diacantha, p. 310 = **Botia** Gray (1831).
C. zebra,* Hamilt., pl. 11, f. 96. flavicauda, pl. 29, f. 95.

Somileptes, p. 311 = **Cobitis** L. (1758).
S. bispinosa,* Hamilt., p. 351. unispina, Ib., No. 1, p. 350.

Platysqualus, p. 318 = **Sphyrna** Raf. (1810).
S. tiburo,* Linn., Russ.,[1] pl. 12, fig. 2.

Pterocephala, p. 321 = **Dicerobatis** Blainville (1828).
P. Giorna,* Lac., v, pl. 20, 3.

Tetrosomus, p. 323 = **Ostracion** L. (1758).
T. turritus,* Bl., pl. 136.

Lactophrys, p. 324 = **Ostracion** L. (1758), subg. **Lactophrys** Sw. (1839).
L. trigonus,* Bl., pl. 35 (? 135). cornutus, Bl., 133.
bicaudalis, Ib., 132. quadricornus, Ib., 134.

Rhinesomus, p. 324 = **Ostracion** L. (1758).
R. triqueter,* Bloch, pl. 130. concatinatus, Ib., pl. 131.

Platycanthus, p. 324 = **Aracana** Gray (1838).
P. auratus,* Shaw, Nat. Miss., pl. 338.

Rhinecanthus, p. 325 = **Balistes** (1758).
ornatissimus,* Lesson, Atl., 10, 1. conspicullum, Ib., pl. 9, 1.
lineatus, Benn., Cey., pl. 10. amboynensis, In. Z., 8, 3.

Melichthys, p. 325 = **Balistes** L. (1758), subg. **Melichthys** Sw.
ringens,* Bl., pl. 152, 2. marginatus, Ib. 2, pl. 15, 1.
albicaudatus, Rüpp. 2, 16, 1. Praslinensis, Frey, Atl., 46, 1.

Canthidermis, p. 325 = **Balistes** L. (1758), subg. **Canthidermis** Sw.
angulosus,* Frey, Zool., p. 210. Gaimardii, Sw., Frey, Zool., p. 209.
oculatus, Ind. Zool., pl. 90, fig. 1.

Chalisoma, p 325 = **Balistes** L. (1758).
C. pulcherrima,* Lesson, Atl., pl. 9, fig. 2. velata, Bl. 150.

Leiurus,[2] p. 326 = **Balistes** L. (1758).
L. macrophthalmus,* Russ., p. 22.
radiatus, Bowdich, Mad., pl. 17, fig. 45.
Russellii, Ib., pl. 23.

Pachynathus, p. 326 = **Triacanthus** Cuv. (1829).
P. triangularis,* Russell, pl. 20.

[1] Said to be the young of *Sphyrna tudes* (Val.) M. & H.

[2] Preoccupied by *Leiurus* Sw., p. 242.

Psilocephalus,[1] p. 327 = **Psilocephalus** Sw. (1839).
P. barbatus,* Gray, Ind. Zool.

Cantherines, p. 327 = **Monacanthus** Cuv. (1817), subg. **Cantherines**[2] Sw. (1839).
C. nasutus,* Frey. Zool., p. 214.

Chætodermis, p. 327 = **Monacanthus** Cuv. (1817), subg. **Chætodermis** Sw.
C. spinosissimus,* Frey. Atl. pl. 45, fig. 3–8.
pennicilligerus, Cuv., Règ., An. pl. 12, fig. 3.

Trichoderma, p. 328 = **Monacanthus** Cuv. (1817), subg. **Amanses** Gray (1831–5).
T. scapus,* Lac. 1, pl. 18, f. 3. histrix, Sw., Gray, Ind. Zool.

Leisomus, p. 328 = **Tetrodon** L. (1758).
T. lævissimus,* Sch., marmoratus, Hamilt., pl. 18, fig. 3.

Lagocephalus, p. 328 = **Lagocephalus** Sw. (1839).
L. stellatus,* Bl., pl. 143. Pennantii, Yarrall, ii, 347 (? 457).

Cirrhisomus p. 328 = **Tetrodon**[3] L. (1758).
C. Sprengleri,* Bloch, pl. 144.

Psilonotus, p. 328 = **Psilonotus**[4] Sw. (1839).
P. rostratus,* Bl. pl. 146. Electricus, Ph. Tr. 76, pl. 3.

Molacanthus, p. 329 = **Molacanthus** Sw. (1839).
M. Pallasii,* Sw. Pall. Spec. Zool. pl. 4.

Astrocanthus, p. 331 = **Halieutæa** Val. (1837).
A. stellatus,* Sw., Lac. i, pl. xi, figs. 2, 3.

Phyllopteryx, p. 332 = **Phyllopteryx** Sw. (1839).
P. foliatus,* Sw. (fig. 109).

Solegnathus, p. 333 = **Solenognathus** Sw. (1839).
S. hardwickii,* Gray, Ind. Zool., i, pl. 89, f. 3.

Ophisoma,[5] p. 334 = **Congromuræna** Kaup. (1856).
obtusa,* Sw., Appendix. acuta, Sw., App.

Leptognathus, p. 334 = **Ophichthys** Ahl. (1789), subg. **Leptognathus**.
L. oxyrhynchus,* Sw., app. (vol. 1, p. 221, fig. 42).

Pterurus,[6] p. 334 = **Moringua** Gray (1831).
P. maculatus,* Ham., p. 25. Triporosa, Russ. i, No. 34.
Hardwickii, Gray, Ind. Zool.

Pachyurus, p. 335 = **Moringua** Gray, (1831).
P. linearis,* Gray, Ind. Zool. i, pl. 95, fig. 3.

[1] = *Anacanthus* Gray, 1831, not of Ehrenberg, 1817.

[2] = *Liononacanthus* Bleeker, 1866.

[3] = *Chilichthys* Müll., 1839.

[4] = *Anosmius* Ptrs., 1855.

[5] Preoccupied by *Ophisomus* Sw., p. 277.

[6] = *Rataboura* Gray, 1831–42.

Ophichthys,[1] p. 336 = **Amphipnous** Müll. (1839).
O. punctatus,* Ham., pl. 16, fig. 4 (*Cuchia*).

Rupisuga, p. 339 = **Lepadogaster** Gouan (1770).
L. nicensis,* Sw., Risso pl. 4, fig. 10 (? fig. 9).

In his "natural arrangement" or analytical key to the groups of Fishes, Swainson introduces several names of genera of which no examples are given and which do not occur further on in the body of the text. They are here given with their equivalence found in the text:—

1. **Cichlaurus**, p. 173 = **Cichlasoma** Sw.
2. **Pteropterus**, p. 180 = **Brachyrus** Sw.
3. **Gobileptes**, p. 183 (not in text).
4. **Psilosomus**, p. 183 = **Amblyopus** Cuv.
5. **Scrophicephalus**, p. 187 (not in text).
6. **Breviceps**, p. 189 = **Felichthys** Sw.
7. **Leiodon**, p. 194 = **Leisomus** Sw.
8. **Canthigaster**, p. 194 = **Psilonotus** Sw.

These names are, in my opinion, unworthy of attention, as in no case would it be possible to understand their author's meaning, were it not for the fuller description given in the text.

[1] Preoccupied by *Ophichthys*, Ahl. (1789).

Note on the Nest of Contopus virens.—Mr. THOMAS MEEHAN exhibited a nest of the "Wood Pewee," *Contopus virens*, built on a dead branch of a black-walnut tree on the grounds of Colonel Etting, of Delaware County, Pennsylvania, showing that it was fastened to the branch by spider's webs, and that the lichens with which the nest was so beautifully ornamented, were evidently attached to the nest in the same manner. There was no evidence of the employment of "viscid saliva" in building the nest, as contended by some ornithological writers.

Mr. Meehan remarked on the great beauty of the nest of this bird, in consequence of the employment of lichens in covering the outside, and observed that so far as human knowledge had yet penetrated, no physiological advantage resulted to this bird by the great trouble it took in this ornamentation, over other birds which were indifferent to such beauty; and we were left wholly, so far, to the conclusion that a love of beauty alone actuates the bird in the preparation of its work.

Note on an Abnormal Cabbage.—Mr. J. O. SCHIMMEL exhibited a plant of cabbage, which, instead of the usual head, made a stalk nearly three feet high, with a panicle of flowers at the top.

Mr. MEEHAN remarked that only on a smaller and weaker scale, this was the normal condition of the cabbage-plant, as he had collected it on the chalky cliffs of the sea-coasts of Europe. In nature the seeds matured in spring, and, falling to the ground, sprouted and made plants at once, which took the rest of the season to prepare for flowering the next spring. But the gardener saved the seed till late in the autumn or very early spring before sowing it, and this favored the vegetative rather than the reproductive system of the plant. In this case the longitudinal growth was arrested, and if we examine the regular cabbage-head, we find ten, fifteen, or often more leaves forming a single cycle round the stem, as in all cases of arrestation of growth—forming of a cone in the pine, for instance—the number of leaves in a cycle were increased. The formation of a head of cabbage was precisely after the method of nature in the making of a pine cone, and this was brought about simply by the change of season of sowing the seed, from that provided by nature. In the case of this specimen, nature had asserted her prerogative to do things in her own way, notwithstanding the change of season by man, though she did not get her way time enough to open the flowers and perfect seed. Here we found only five leaves to a cycle, and as we saw by the overlapping bases of the leaves, which formed the cabbage-stalk, the spiral arrangement was from left round to the right, or "with the sun."

Earthworms Drawing Leaves into the Ground.—Mr. POTTS exhibited a box of earth showing the action of the earthworm

drawing weeping-willow leaves into the earth. Most of them were drawn into the earth by the petioles, which being the easiest way, is referred to by Mr. Darwin in his work on the earthworm, as exhibiting intelligence in these humble creatures.

Mr. MEEHAN remarked that, though he had seen in England leaves drawn into the earth as described by Mr. Darwin, he had never seen a case in America, until those exhibited by Mr. Potts, though for many years he had had opportunities of observations enjoyed by few. The apparent rarity of this work of the earthworm in this country was worthy of consideration in connection with the objects of the creature in performing it.

Mr. POTTS stated that the ground beneath a willow tree in his garden was unusually well stocked with earthworms, many of them of large size. The damp weather of the last week or two had brought them to the surface at a time when the willow leaves, still green and succulent, were rapidly falling. These the worms collected during the night, drawing them down into their burrows, he thought, to an average depth of one inch per day or night.

The appearance of the neighborhood by daylight was very curious. Throughout the garden-beds, the grass-plot, the gravel-walk and even along the cracks of the brick pavement, wherever their burrows had reached the surface, the busy tenants had "planted" these leaves perpendicularly, sometimes singly, frequently in tufts of six, eight or more, giving the appearance of a child's play-garden or of the slip-boxes in a gardener's greenhouse.

On digging up the tufts, worms were generally found with an extremity near the base of the leaves; and here the latter seemed moistened and frayed as by a process of feeding. The phenomenon was not entirely novel, but he had never noticed these "worm-plantings" in such numbers before.

NOVEMBER 21.

The President, Dr. LEIDY, in the chair.

Thirty-two persons present.

Remarks on Ursus amplidens.—Mr. JACOB WORTMAN called attention to a specimen originally described by Dr. Leidy in the Proceedings of the Academy of Natural Sciences, Philadelphia, for the year 1853, and republished and figured in the Journal of the Academy for the year 1856, under the name *Ursus amplidens*, from near Natchez, Mississippi.

The specimen upon which the description of the species was based, consists of the posterior portion of the left mandibular ramus, containing the third or last true molar tooth in position,

also a first true molar of the upper series, belonging to the left side of the jaw.

That this specimen is distinct from our black bear or *Ursus americanus*, there can be no doubt. Both the size and structure of the teeth distinctly forbid its reference to this species. The only differences, however, that he had been able to find between it and the typical grizzly bear, or *Ursus ferox*, consist in its smaller dimensions, and a slight exaggeration of the anterior basal lobe of the first true molar.

The geographical position of this specimen, together with this slight variation of structure, appear to have been important factors in establishing its claim to rank as a new and a distinct species.

With reference to the geographical position it may be said that there are many familiar examples of the various species of bears, enjoying a much wider geographical distribution than the existing grizzly bear or *Ursus ferox*. The black bear or *Ursus americanus* is well known to inhabit the extreme eastern and western portions of the North American continent, and ranges well to the north and the south. The polar bear or *Ursus maritimus*. inhabits almost, if not quite, the entire polar circle; and, indeed, Mr. G. Busk has in the Transactions Philos. Soc. of London, 1873, and later in Trans. Zoolog. Soc. London, for the year 1877, established the identity of *Ursus fossilis* of Goldfuss or *Ursus priscus*, Cuvier and Owen, with our existing grizzly bear or *Ursus ferox*.

In view of the fact, therefore, that the grizzly bear is now known to have inhabited Europe during Post Pliocene time, thereby greatly extending the boundaries of its present limits, little importance need be attached to a comparatively slight deviation from its present geographical range.

There is, probably, no family among the mammalia which is subject to greater variation, in size and structure, than the *Ursidæ*. The grizzly bears inhabiting the mountains of California and Oregon, are larger and more robust than those living upon the eastern slope of the Rocky Mountains. So far, indeed, is this true, that some authors have made two distinct species of them. The bear of the Rocky Mountain region is familiarly known to hunters as the "silver-tip bear," and is said to display even more pugnacity of character than the true California grizzly.

The small size of the individual under consideration is in keeping with what we should reasonably expect to find at a point considerably to the east of the present boundary of the range of this species.

The measurements of the crown of the last lower molar, are as follows: Antero-posterior diameter, ·75 inch; transverse diameter, ·60 inch. The crown of the first upper molar measures in the antero-posterior diameter ·82 inch, while in the transverse diameter it is ·64 inch.

The average dimensions of the corresponding tooth of *Ursus*

ferox, as given by Mr. Busk in Trans. Philos. Soc, 1873, p. 542, are ·92 by ·62 inch in the transverse, with a minimum dimension of ·85 by ·55 inch.

The experience of the speaker upon examination of quite a number of skulls of this species, had been to reduce the minimum dimension, recorded by Mr. Busk, which would affect the general average.

In one young but well marked specimen of *Ursus ferox*, in the collection of the Academy, the dimensions of the crown of the last lower molar are ·77 by ·62 inch. In another fully adult individual, bearing all the characteristics of the species, the measurements of this tooth are ·75 by ·57 inch. The dimensions of the first superior molar in this specimen are the same as those in the fossil specimen under consideration. It will be observed, therefore, that *Ursus amplidens* is intermediate in size between these two well defined specimens of *Ursus ferox*.

There is no character left by which we can distinguish this species, but the slight exaggeration of the anterior basal lobe of the superior molar, which is so very variable as to be almost worthless for this purpose.

Ursus amplidens is, therefore, but a variety at best, if not identical with the smaller varieties of *Ursus ferox*.

NOVEMBER 28.

The President, Dr. LEIDY, in the chair.

Forty-one persons present.

The deaths of Dr. J. F. Reinhardt and Dr. F. H. Troschel, correspondents, were announced.

Note on Zeolites from Delaware County.—Prof. GEO. A. KÖNIG communicated an observation on specimens received through Mr. A. Deshong from the Leiperville quarries. The whole of the material is from one crevice. One piece shows the association of gray quartz, yellowish grossularite, a chloritic mica, beautiful rose-red zoisite, and small crystals of heulandite, previously described by the speaker (Proceedings 1878, p. 84).

A second piece of biotite mica-schist shows in several druses seemingly botryoidal masses, which under the lens show coxcomb aggregations and are stilbite. Alongside one observes grains of zoisite surrounded by deep green, waxy Leidyite, the surface of which is generally covered with a very thin film of an undetermined greenish gray substance.

The remaining specimens show upon the same rock largely rhombohedral crystals of chabazite; some vitreous, but mostly covered by green, waxy Leidyite. This substance supports many

minute crystals of red-brown siderite and the latter passes into limonite. With these one sees sheaf-like aggregations of a zeolite, which from the form of single crystals appears to be Thompsonite. Some of these crystals are beautifully transparent, with tetragonal habitus—two opposite prismatic faces are striated longitudinally (pinakoïd), basis and macrodome are found on all individuals. The crystals are, however, very small and cannot be measured satisfactorily. Analyses have not been made. The determinations are not, therefore, absolute, except in the case of chabazite. The resemblance of this occurrence to that of Baltimore is very striking. Thompsonite is new for Pennsylvania, chabazite and stilbite for Leiperville, in the speaker's knowledge.

Chapter V, Article 4, of the By-Laws, was amended by adding the following:—But Sections may admit persons not members of the Academy to be Contributors under such rules and on such terms as the Section may determine, always provided, that a Contributor shall not be eligible to office in a Section, or to vote on any question; and also provided, that the rights and privileges of a Contributor shall be restricted to attendance at the meetings of the Section, to the reading of original scientific papers, and to taking part in scientific discussions and proceedings exclusively, and that a Contributor shall have no other right or privilege whatever in the Academy.

F. Lynwood Garrison and Mrs. H. Carvill Lewis, were elected members.

DECEMBER 5.

Mr. THOS. MEEHAN, Vice-President, in the chair.

Twenty-five persons present.

A paper, entitled "On Uintatherium, Bathmodon and Triïsodon," by Edw. D. Cope, was presented for publication.

DECEMBER 12.

The President, Dr. LEIDY, in the chair.

Forty-five persons present.

The following papers were presented for publication:—

"An Identification of the Species of Fishes described in Shaw's General Zoology," by Jos. Swain.

"On the Value of the Nearctic as one of the Primary Zoological Regions," by Angelo Heilprin.

On Remains of Horses.—Prof. LEIDY directed attention to some specimens, which were recently sent to him for examination by the Secretary of the Smithsonian Institution. He remarked that it was commonly believed that the horse was not living in America when this was discovered by Europeans, but there is abundance of evidence to prove the former existence in this country of many species and genera of closely related forms. Among the remains of these some are undistinguishable in anatomical characters and size from the corresponding parts of the domestic horse. As this during the past four centuries has become widely and abundantly distributed over both continents, its remains have become buried everywhere, and often in the older deposits, where they are mingled with the fossils pertaining to the latter. Under these circumstances it is commonly difficult and frequently impossible to determine whether specimens submitted to us for examination are to be regarded as true fossils or comparatively recent remains. Such is the character of the specimens now exhibited.

Several consist of fragments (No. 16537–8) of the left ramus of the mandible of a horse. They were obtained at Aspinwall, Panama, by Capt. J. M. Dow; but no reference is made to the nature of the deposit in which they were found. They are well preserved, firm in texture, without fissures, and stained brown from ferruginous infiltration. One of the fragments contains the molar series nearly perfect except the first and last. They are more than half worn away and agree closely with those of the domestic horse in the same condition.

Other specimens consist of an astragalus and a first phalanx (16602, 16604) of a horse of the ordinary size. They were obtained by Mr. J. F. Le Baron, U. S. Assist. Eng., on Peace Creek, Florida, in 1881, during the survey of a steamboat route from the St. John's River to Charlotte harbor. They were discovered in association with remains of the elephant, *Elephas columbi*, and a huge turtle remarkable for the thickness of its shell, etc. The specimens are black and well preserved, but exhibit no peculiarity.

The remaining specimens are of more interest than the preceding, and consist of two bone fragments and three teeth (Nos. 1–5, 11629), which were obtained by Mr. Ellis Clarke, Jr., from near Lacualtipan, Hidalgo, Mexico. According to the accompanying letter, they were discovered in a thirty inch clay bed, lying between an upper four inch, and an under four feet stratum of coal, overlying a limestone with small shells. The fossils belong to the three-toed horse, *Hippotherium* (*Hipparion*), and are probably of pliocene age, though they may be miocene.

Of the bone fragments one is the upper extremity of a meta-

tarsal, exhibiting on each side behind the articular impressions of the smaller metatarsals. The articular end measures 13 lines transversely and 11 lines fore and aft. The other fragment is the proximal articular end of a first phalanx, measuring 14 lines transversely and 8 lines fore and aft. Of the teeth two are lower molars, apparently of different individuals. One, a fourth or fifth of the series, is little worn, but has lost its exterior cementum. It is about 2 inches long and at the triturating surface measures 9 lines fore and aft and $4\frac{1}{2}$ lines transversely. The other lower molar, probably the third of the series, is about half worn, but is broken away below, and yet retains its outer cementum. It measures 9 lines fore and aft and 5 lines transversely. The remaining tooth, the most characteristic of the specimens, is an upper molar, apparently the fourth of the series of the right side. It is but little worn, is well preserved and retains its exterior cementum. It measures about 2 inches long and at the triturating surface is $9\frac{1}{2}$ lines fore and aft and 9 lines transversely.

The specimens indicate a species about the size of *Hippotherium venustum* and *H. speciosum*, but the folding of the enamel on the triturating surface of the upper molar, as represented in the accompanying figure, is sufficiently different from the arrangement in the corresponding teeth of those species, to render it probable that the fossils belong to neither of them.

In *H. venustum* the inner column of the superior molars, so far as known, is regularly cylindrical; in *H. speciosum* it is compressed cylindrical. In the tooth under inspection it is much wider than in the latter. The fossils probably indicated an undescribed species, and for this the name *Hippotherium montezuma* was suggested.

Prof. Cope remarked that he believed that the contemporaneity of man with the horse and other extinct pliocene mammals in Western North America would soon be satisfactorily demonstrated. The first evidence on the subject was furnished by J. D. Whitney, Chief of the Geological Survey of California, in the case of the Calaveras skull, which was said to be taken from the gold-bearing gravel; and in several other cases subsequently added. From the fact that scientific observers were never present at the unearthing of the remains of man and his works from this formation, the evidence has been generally regarded as inconclusive. The gold-bearing gravel of California is, however, a very peculiar formation, and an object buried in it would carry such marks of its origin as to be quite recognizable. This was the case with the Calaveras skull when first discovered, as I am informed by Prof. Verrill of Yale College. This gentleman states that the skull, when found, was partially filled and covered with the hard adhesive "cement" so characteristic of the formation.

Prof. Cope referred to two observations of his own made in

1879 in Oregon[1] and California,[2] which were confirmatory of the existence of man in the upper pliocene of both those States, but the evidence was in neither case absolutely conclusive.

The discovery that the tracks of several species of pliocene mammalia[3] in the argillaceous sandstones of the quarry of the Nevada State Prison at Carson, are accompanied by those of a biped resembling man, is a further confirmation of these views. The tracks are clearly those of a biped, and are not those of a member of the *Simiidæ*, but must be referred to the *Hominidæ*. Whether they belong to a species of the genus *Homo* or not, cannot be ascertained from the tracks alone, but can be determined on the discovery of the bones and teeth. In any case the animal was probably the ancestor of existing man, and was a contemporary of the *Elephas primigenius* and a species of *Equus*.

Professor Lewis drew attention to the caution that should be taken in accepting as evidences of pliocene man any facts as yet not verified by scientific observers. While the facts proving a post-glacial man are indisputable, the existence of pre-glacial man, either in our own country or in Europe, is not attested by satisfactory evidence. The discoveries in California, just referred to, made for the most part by miners in their search for gold, carry with them several serious objections to the great antiquity assigned to the relics thus found.

In the first place, the characters of the implements are identical with those of modern workmanship, while the Calaveras skull closely resembles that of a modern Indian. The implements, consisting of large granite mortars, polished spearheads of obsidian, gaming disks, finely marked pendants of greenstone and syenite, hammers, pestles, arrowheads, beads, etc., are of quite as perfect workmanship as those produced by the present aborigines of the country. No modern implements surpass the beauty of the obsidian spearheads thus found. The fact is not generally mentioned that implements in all respects similar to those of the auriferous gravel occur upon the surface of the ground, having been made by well-known tribes. Nor is the skull in any way inferior to those of the present day.

Moreover, there is no evidence of the great antiquity either of the Calaveras skull or of the implements by the amount of weathering or corrosion that they have suffered. Unlike the palæolithic implements of Europe and of Eastern America, the spearheads and mortars of the Californian gravels are as fresh in appearance as those made by modern tribes. Nor is the compact gravel adhering to the Calaveras skull a mark of great antiquity, since the formation of even more compact gravels and conglomerates may occur

[1] American Naturalist, 1880, p. 62.
[2] Loc. cit, 1878, p. 125.
[3] Loc. cit., 1881, p. 195 and 921.

in quite recent times. It is unnecessary here, in support of this fact, to more than mention the modern coins and other objects so frequently found in a compact gravel firmly cemented.

Again, there is no sufficient evidence that the gravel in which many of these relics were reported to have been found was undisturbed. Most of the implements were found on the banks of streams, some of them in the bottom of river-beds, in both of which places landslips may have occurred, while the few found in shafts have never been satisfactorily demonstrated to lie in a position which could not have been disturbed.

The very fact that these relics all occur in a gold-bearing gravel may indicate the method by which many of them were buried. That gold-mining was carried on in these same gravels by the aborigines upon an extensive scale is well attested. Schoolcraft describes an ancient shaft which penetrated Table Mountain to a depth of 210 feet, at the bottom of which were human bones and implements. This is the very locality where a number of implements and a skull of supposed pliocene man were afterwards found. Other authorities might be quoted to show the numerous mining operations of the aborigines. The mortars already described were probably used in the process of extracting gold from the gravel.

Another point of importance is the fact that the earliest relics of man, either in the river gravels of Europe and Great Britain, or in those of the Delaware, are of an ancient type, unlike those of more recent times. These *palæolithic* implements, with the associated bones of animals now extinct, are the most certain evidences of primeval man, and belong to the age immediately following the glacial epoch. It is not, therefore, probable that the highly fashioned implements of California, having the most neolithic type, belong to a race of pre-glacial men anterior to those of the river gravels of Europe. The argument from analogy is so strong against the great antiquity of the Californian relics, that evidence of the most satisfactory kind must be required to support such a conclusion.

The following was ordered to be published :—

ON UINTATHERIUM, BATHMODON AND TRIISODON.

BY E. D. COPE.

Bathmodon pachypus Cope, sp. nov.

The species originally described by me under the name of *Bathmodon radians*, was based on a number of specimens obtained by Dr. Hayden, from the Wasatch formation near Evanston, Wyoming. I subsequently ascertained that this material included two species, a larger and a smaller. The latter I described under the name of *Bathmodon latipes*[1]: for the larger the name of *Bathmodon radians* was retained. Besides various diversities between the skeletons of these species, their astragali exhibit characters which indicate that the genus *Bathmodon* is distinct from *Coryphodon*, although I have admitted their supposed identity in some of my publications.[2] I pointed out the differential characters of the two genera in 1882,[3] but did not then express the most important feature. I then defined *Bathmodon* as follows: "Astragalus subquadrate, without internal hook," and *Coryphodon*, "Astragalus transverse, with internal hook." The absence of the internal prolongation of the astragalus in *Bathmodon*, is due to the presence of a facet for articulation with some bone, which is not found in *Coryphodon*. This may have been a proximal prolongation of the entocuneiform, or perhaps a distinct bone, or even the proximal extremity of the metacarpus of the hallux.

Besides the *B. radians*, I am acquainted with a second species of superior dimensions. The remains consist of a pelvis with femur and several bones of the posterior leg and foot, and the humerus and radius of the foreleg. These bones are as long as those of the largest known *Coryphodon* (*C. anax*), and are more robust. In description of this new species, which I call *Bathmodon pachypus*, I give the following dimensions:—

[1] Annual Report U. S. Geolog. Survey Terrs., 1872, p. 588.

[2] Report U. S. G. Survey W. of the 100th Meridian, iv, 1877, p. 187.

[3] American Naturalist, Jan. 1882, Proceeds. Amer. Philos. Society, 1881, p. 165.

		M.
Length of humerus,		·400
Diameters of proximal extremity	anteroposterior,	·107
	transverse oblique,	·159
Width at epicondyles,		·166
Diameters of condyles	transverse,	·112
	anteroposterior roller,	·058
	anteroposterior flange,	·087
Length of pelvis antero-posteriorly,		·600
Chord of crest of ilium,		·350
Anteroposterior width of peduncle ilium,		·110
Length of ischium from acetabulum,		·150
Length of pubis to symphysis do.,		·160
Length of femur,		·527
Width of femur proximately,		·160
Diameter of head of femur,		·080
Diameter of shaft above third trochanter,		·066
Diameter of shaft at third trochanter,		·106
Width of condyles of femur,		·134
Depth of condyles with rotular crest,		·126
Diameters of astragalus above	anteroposterior,	·0675
	transverse,	·0800
Length of calcaneum,		·100

From the Wasatch of the Big Horn, J. L. Wortman.

Uintatherium robustum Leidy.

I have for some years had in my possession a fragmentary lower jaw from the Bridger beds of Wyoming, which I have been unable to refer to its proper place in the system. It is described in part in the Annual Report of the U. S. Geological Survey of the Territories, 1872, p. 565. The rami support roots and crowns of six molars, and the symphysis has two alveoli on each side. The peculiarity of the animal consists in this latter fact, since the species so far as described, are said to have four teeth on each side of the symphysis, viz., three incisors and one canine. Those present in the present species I suppose to be incisors. The molar teeth are so much like those of *Uintatherium robustum*, that I believe the specimen to belong to that species.

Symphysis very much compressed, so that the incisor teeth of opposite sides are close together; its inferior outline curved

upwards to the alveolar edge, in an obtuse keel. Base of flange for superior canine distinct, commencing below the posterior edge of the posterior alveolus, and immediately preceded by a mental foramen. Middle line of symphysis rugose. Ramus at last molar robust, owing to the prominence of the inferior part of the anterior masseteric ridge. In connection with the oblique position of the head, the inferior molars are oblique to the long axis of the ramus, sloping upwards and backwards, with exposed anterior roots. The molars increase in size posteriorly, and the last one is abruptly larger than the penultimate. Their structure is as in *U. robustum*, *i. e.*, with an obliquely transverse high crest in front, and a low posterior transverse edge of the heel, and a short oblique crest between the two. The last named is short, and is directed obliquely outwards and forwards towards the external extremity of the anterior crest, but disappears before reaching it. The internal extremity of this and of the low posterior crest, with the external extremity of the anterior crest, rise into cusps. At the middle of the anterior base of the anterior transverse crest there is a tubercle, which represents the anterior limb of the anterior V in *Coryphodon*. The crowns of the premolars are broken away in the specimen.

The alveoli of the incisors are flat, and are directed forwards at an angle of only 20° from the horizontal until near their orifices, where the angle is greater. The roots of the incisors are thus curved upwards and forwards. There is but little space between the anterior alveolus and the anterior angle of the symphysis.

Measurements.		M.
Length from anterior edge of symphysis to anterior base of canine flange,		·074
Width of symphysis below at bases of lateral flanges,		·032
Depth of symphysis between do.,		·040
Width of symphysis above between posterior incisors,		·017
Length of bases of posterior five molars,		·148
Length of bases of true molars,		·110
Diameters crown, m. ii,	anteroposterior,	·031
	transverse in front,	·020
Diameters crown, m. iii,	anteroposterior,	·035
	transverse in front,	·025
Width of ramus at posterior edge of m. iii,		·040

Although the crowns are somewhat worn, the enamel is wrinkled intermediately between coarse and fine.

The specimen described was obtained in the Bridger beds on Henry's Fork of Green River, Wyoming.

Triisodon conidens Cope.

A right maxillary bone and corresponding mandibular ramus represent this species in my collection. The former sustains the last five molars, and the latter the last three, with alveoli of the others and of the canine tooth. The pieces indicate a skull of the size of that of the wolf, and a good deal more robust in its vertical measurements.

The third superior premolar has a base of triangular outline, the external side longer than either of the internal, which are connected by a broadly rounded angle. The external cusp is of lenticular section at the base, and circular section near the apex. An internal cusp is represented by a strong cingulum as in *Periptychus*, which connects with the posterior base of the external cusp. The crown of the fourth superior premolar has a triangular base of which the anterior side is shorter than either of the other two, which are subequal. The external cusp is large, simple, and subconic. The internal is distinct but smaller and is continued posteriorly as a cingulum to the posterior base of the external cusp. No internal cingulum. The crown of the first true molar is worn to the roots. The second true molar is the longest of the series. Its base is a triangle, placed transversely to the axis of the jaw, of which the external side is the shortest, the anterior the next longer, and the posterior the longest. The apex or internal extremity of the crown is obtusely rounded. There are two subequal external cusps, which are injured in the specimen. The internal cusp is the apex of a V whose limbs form the anterior and posterior edges of the grinding face of the crown, extending outwards to near the bases of the external cusps. Posterior to the posterior one is a strong basal cingulum. No internal, and a faint anterior cingulum. There is probably an external cingulum, but it is broken away. The last molar is of an oval outline placed transversely to the cranial axis, both the external and internal extremities contracted, the latter a little the more so. There is a large anterior external conical cusp. The posterior external is small, and is situated at the posterior third of the posterior border of the

crown. The internal cusp is well developed, and has a subcircular section. There are strong external and posterior cingula, and a weak anterior one, but no internal cingulum. The posterior extremity of the maxillary bone within the zygoma, is immediately above the posterior border of the last superior molar.

Measurements of Superior Molars.		M.
Length of bases of posterior five,		·069
Diameters base, Pm. iii,	anteroposterior,	·013
	transverse,	·009
Diameters base, Pm. iv,	anteroposterior,	·0145
	transverse,	·014
Length base of true molars,		·039
Diameters base of m. ii,	anteroposterior,	·0175
	transverse,	·021
Diameters base, m. iii,	anteroposterior,	·010
	transverse,	·0175
Elevation of base of zygoma, above base of m. iii,		·018

The ramus of the lower jaw is, as usually with the Creodonta, deeper and less robust than that of Carnivora of corresponding size. It is also more compressed than that of the *Triïsodon quivirensis.* It retains its depth to below the canine teeth, and does not shallow below the middle of the coronoid process, where also there is no tendency to inflection. The anterior masseteric ridge is not very prominent, and the masseteric fossa is not defined below, nor is the inferior edge of the ramus prominent or ridged at that point.

The premolar teeth are lost, but they occupied but a short space, and were probably only three in number. The first and second true molars are subequal, while the third is a little smaller than either. Each consists of an anterior higher and a posterior lower portion, the lower region being at the junction of the two. The anterior part has a nearly circular section, and contracts towards the apex. The latter is divided into three cusps, a larger external and two lesser internal. The external and posterior internal soon fuse on wearing, and their combined section is a crescent. The anterior inner is small and stands near the inner edge of the crown, and not at the middle as in *T. quivirensis*, and is circular in section. The heel of the tooth rises to its posterior border, which is divided into two cusps. Each of these sends a

ridge forwards towards the base of the anterior cone of the tooth. The external is the larger, and reaches that base. The internal is smaller, and falls short of it. The posterior inferior molar differs from the others in form as well as in size. There is no posterior inner anterior cusp, the large external cusp being supplemented by a small anterior internal only, which sends a little ridge downwards and posteriorly. The heel is narrowed, and supports the two cusps on its posterior border in contact, and not separate as on the other teeth. The external is the larger, and extends forwards to the base of the anterior cone near its middle. Some remnants of hard matrix leave it uncertain whether there is a small median posterior marginal tubercle on the first and second molars or not.

The first inferior true molar has a strong external cingulum; the second has none; the third has one, which is most evident between the cusps, is weaker at the base of the posterior lobe, and faint at the anterior lobe. No internal cingula.

Measurements.		M.
Length of true molar series,		·052
Length from m. iii to anterior masseteric ridge,		·013
Diameters of m. i,	anteroposterior,	·017
	transverse,	·0115
Diameters of m. ii,	anteroposterior,	·018
	transverse,	·011
Diameters of m. iii,	anteroposterior,	·016
	transverse,	·0105
Depth of ramus at m. iii,		·047
Width of ramus at m. iii, inferiorly,		·013

The molar teeth of this species are more like those of the *T. heilprinianus* than those of the *T. quivirensis*. This is seen in the more conic character of the anterior lobe of the tooth, and the better development of the anterior inner cusp. The species is a good deal larger than the *T. quivirensis*.

From the Puerco beds of N. W. New Mexico, D. Baldwin.

NOTE.—The superior molar teeth show a resemblance to those of *Mesonyx*, and also to those of *Deltatherium*. Among the *Mesonychidæ*, *Triïsodon* approaches *Sarcothraustes* in the form of the inferior molars, in the expanded heel. On the other hand, the

appearance of the anterior cusp of the inferior molars approaches what is seen in *Amblyctonus*. The small transverse posterior superior molar of *Triïsodon* further distinguishes it from *Amblyctonus*. A series of modifications of the dental characters proceeding from the simple to the more complex, may be constructed as follows: 1. *Mesonyx;* 2. *Dissacus;* 3. *Sarcothraustes;* 4. *Triïsodon;* 5. *Amblyctonus;* 6. *Deltatherium*. The first three belong to the *Mesonychidæ*, as distinguished by the form of the tarsal articulations. Whether *Triïsodon* must be arranged with *Amblyctonus* or not, cannot be ascertained until the foot structure is known.

DECEMBER 19.

The President, Dr. LEIDY, in the chair.

Thirty-five persons present.

The deaths of Jos. S. Lovering, Jr., and Dr. John Forsyth Meigs, members, were announced.

On an extinct Peccary.—Prof. LEIDY said he regarded it as remarkable, that among the mulitude of remains of extinct mammals found in this country, many of which were of genera common to the old world, no well authenticated remains of Hippopotamus and of the Hog had been discovered. The representative of the latter in this country is the Peccary, of which there are two known living species, pertaining to South America, with one of them extending into Mexico and Texas. The remains of a number of extinct species have been found in the United States and territories, partly referable to *Dicotyles*, and others to a nearly allied genus, described by Dr. Le Conte under the name of *Platygonus*. In this the constituent lobes of the molar teeth are conspicuously prominent, comparatively smooth, and approximate in form those of ruminants. In *Dicotyles* they are comparatively low, wrinkled, and approximate more those of the hog.

Several fossil specimens exhibited, probably indicate an undescribed species of *Platygonus*, larger and of more robust proportions than the *P. compressus*. They have been submitted for examination by Mr. Wm. B. Henderson, who reports that they were found in clay and gravel, in a limestone quarry, in Mifflin Co., Pa. They consist of two jaw fragments with teeth, the bone being encrustated with a hard ferruginous cement of limestone and gravel. The lower jaw fragment contains the greater part of the last two molars. The jaw below the position of the first molar is thick and shallow; below the last tooth it abruptly deepens, and a short distance back is nearly double the depth. The upper jaw fragment contains the greater part of the molars and last premolar. The upper teeth exhibit a well produced basal ridge fore and aft, but none laterally, except the feeble elements of it between the lobes of the crowns.

Comparative measurements of the two fossil specimens with corresponding parts in the skull of *P. compressus* are as follows:

	P. vetus.	P. compressus.	
Depth of lower jaw below first molar,	42 mm.	37 mm.	49
Thickness of lower jaw below first molar,	22 "	17 "	18
Depth of lower jaw back of last molar,	78 "	45 "	65
Space occupied by the last two molars,	47 "	38 "	35

	P. vetus.	P. compressus.	
Fore and aft diameter of second molar,	21 mm.	17 mm.	16
Transverse diameter of second molar,	15 "	11 "	13 12
Fore and aft diameter of last molar,	28 "	[illegible] "	21
Transverse diameter of last molar,	16 "	12 "	13
Breadth of face outside last premolars,	56 "	45 "	46
Breadth of face outside last molars,	68 "	52 "	62
Space occupied by upper molars,	62 "	50 "	44
Fore and aft diameter of first molar,	17 "	13 "	
Transverse diameter of first molar,	16 "	12 "	
Fore and aft diameter of second molar,	20 "	17 "	
Transverse diameter of second molar,	18 "	14 "	
Fore and aft diameter of last molar,	24 "	21 "	
Transverse diameter of last molar,	19 "	14 "	
Fore and aft diameter of last premolar,	12 "	11 "	
Transverse diameter of last premolar,	15 "	11 "	

The species may be named PLATYGONUS VETUS, though it is by no means certain that it does not pertain to one of the forms described by Prof. Marsh, from the western territories.

The following was ordered to be printed :—

AN IDENTIFICATION OF THE SPECIES OF FISHES DESCRIBED IN SHAW'S GENERAL ZOOLOGY.

BY JOSEPH SWAIN.

In the early part of the present century, Dr. George Shaw compiled a "General Zoölogy" or "Systematic Natural History," which was to contain descriptions of all the animals then known. In the two volumes on fishes,[1] he introduced a large number of new specific names, most of them arbitrary, and unwarranted alterations of prior names, the rest chiefly for species described by travelers, which had been for one reason or another left without binomial designation. Of all the various compilations of the kind, pertaining to fishes, this work of Shaw's is probably the least worthy. Some of the names, however, have priority of date. I here give a list of all the new generic and specific names introduced by Shaw, with the name which the form in question should bear, so far as I can ascertain it.

Cases involving difficulty of identification or doubt as to proper nomenclature, have been referred to Prof. Jordan, to whom I am also indebted for numerous suggestions, and for the use of his library.

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NAME.		PAGE.	IDENTIFICATION.
Anguilla vulgaris,	pl. 1,	15	Anguilla vulgaris,[2] Shaw.
Muræna romana,		26	Muræna helena, L.
Muræna africana,		30	Sidera afra (Bloch), Swain.
Muræna meleagris,		32	Sidera meleagris (Shaw), Swain.
Muræna[3] viridis,		33	? Ophichthys, sp.
Monopterus javanicus,		39	Monopterus javenensis, La Cépède.
Odontognathus abdomine aculeata,	pl. 8,	74	Odontognathus mucronatus, La Cépède.
Triurus[4] commersonii,		78	?
Genus Stylephorus,		87	Genus Stylephorus.

[1] General Zoology of Systematic Natural History, by George Shaw, M. D., F. R. S., etc., with plates from the first authorities and most select specimens. Engraved principally by Mr. Heath, London (vol. iv, 1803; vol. v, 1804).

[2] Prior to *Anguilla vulgaris* Turton (1806), and Rafinesque (1810).

[3] *Muræna viridis* is based on "*Serpens Marinus americanus*, Seb. 3, t. 70, f. 2," apparently not identifiable.

[4] Based on *Triurus bougainvillianus* La Cépède, ii, 201.

NAME	PAGE.	IDENTIFICATION.
Stylephorus cordatus,	pl. 11, 87	Stylephorus cordatus, Shaw.
Xiphias platypterus,	pl. 15, 101	Xiphias gladius, Linnæus.
Xiphias makaira, .	pl. 16, 104	Histiophorus gladius (Brouss.) La C.
Gadus[1] leverianus,	. . 153	?
Blennius trifurcatus,	. . 174	Raniceps trifurcus (Walb.), Cuv.
Cepola hermanniana,	. . 191	Tænioides hermannii,[2] La Cépède.
Gymnetrus ascanii,	pl. 27, 193	Regalecus glesne, Ascan.
Genus Vandellius, .	. . 199	Lepidopus (Gouan), Bl. & Schn.
Gobius ater, . . .	. . 243	Gobius ater,[3] Shaw.
Gobiomorus australis,	. . 249	Eleotris strigata (Brouss.), C. & V.
Cottus[4] australis, .	. . 263	?
Scorpæna commersonii, .	. . 271	Pterois volitans (L.), C. &. V.
Scorpæna bicapillata,	pl. 40, 273	Synancia bicirrata (La C.), Swain.
Scorpæna brachiata,	. . 274	Synancia verrucosa, Bloch.
Zeus opah, . .	pl. 42, 287	Lampris guttatus (Brünnich), Retzius.
Pleuronectes roseus,	pl. 43, 302	Pleuronectes flesus, L.
Pleuronectes rondeletii, .	. . 307	Solea ocellata (L.), Günther.
Pleuronectes[5] argenteus, .	. . 308	?
Pleuronectes diaphanus, .	. . 309	Arnoglossus laterna (Walb.) Günt.
Pleuronectes tuberculatus,	. 312	Psetta maxima (L.), Swainson.
Chætodon imperialis,	pl. 41, 324	Holacanthus imperator (Bloch.), La C.
Chætodon bifasciatus,	. . 342	Heniochus macrolepidotus (L.), C. & V.
Chætodon plectorhynchus,	pl. 49, 356	Plectorhynchus chætodontöides, La C.
Acanthurus nasus,	pl. 51, 376	Monoceros tuberosus (LaC.), Swain.
Acanthurus[6] militaris,	. . 380	Acanthurus, sp.
Acanthurus harpurus,	. . 381	Monoceros lituratus (Forst.) Swain.
Acanthurus achilles,	. . 383	Acanthurus achilles, Shaw.
Acanthurus[7] umbratus, .	. . 384	?

[1] Described from a specimen in the Leverian Museum, which is "supposed" to be a native of the Southern Ocean, being placed in a collection of fishes taken during the last voyage of Captain Cook.

[2] Not *hermannianus*, as usually quoted.

[3] *Gobius ater* Shaw, is based on *Gobius niger* La C. (not of Linnæus). If this is a valid species, it seems to have been overlooked by other writers.

[4] *Cottus australis* Shaw, is "a doubtful species; described by myself in Mr. White's Voyage to Botany Bay" (Shaw).

[5] *Pleuronectes argenteus* is based on a partial description by Petiver, in "Gazoph. 10, t. 26."

[6] "Native of the Indian and American seas. In the British and Leverian Museums." (Shaw.)

[7] "Native of the Indian seas. In the British Museum." (Shaw.)

NAME.	PAGE.	IDENTIFICATION.
Acanthurus[1] meleagris, . .	385	?
Trichopus arabicus, . .	390	Thalassoma lunare (L.), Swain.
Trichopus satyrus, . .	391	Osphromenus goramy, La Cépède.
Trichopus pallasii, . .	392	Osphromenus trichopterus (Pall.), Günther.
Trichopus monodactylus, .	392	Monodactylus falciformis, La Cépède.
Scarus purpuratus, . .	397	Thalassoma purpuream (Forsk.), Swainson.
Scarus[2] rostratus, . . .	401	?
Sparus[3] bicinctus, . . .	418	?
Sparus brunnichii, . .	424	Sparus bogaraveo, Brünn.
Sparus commersonii, . .	428	Gerres oyena (Forsk.), Cuv. & Val.
Sparus melanotus, . . .	431	Lutjanus argentiuaculatus (Forsk.), Swain.
Sparus luna, ...	433	Lutjanus chrysurus (Bloch), Vaill.
Sparus serran, . . .	439	Serranus cabrilla (L.), Risso.
Sparus[4] sciurus, . pl. 64.	439	Serranus formosus (L.), J. & G.
Sparus argyropthalmus,	441	Priacanthus[5] macrophthalmus (Bloch), Swain.
Sparus[6] reticulatus, . .	447	?
Sparus zonatus, . . .	452	Thalliurus fasciatus (Thun.), Swn.
Sparus hemisphæricus, pl. 66,	554	Xyrichthys fuscus (La C.), Swain.
Sparus brachiatus, pl. 66,	456	Xyrichthys fuscus (La C.), Swain.
Sparus magnificus, . .	463	Conodon nobilis (L.), J. & G.
Sparus[7] palpebratus, . .	464	?
Sparus tranquebaricus, . .	471	Lutjanus johnii (Bloch), Vaill.
Sparus semifasciatus, . .	472	Epinephelus striatus (Bloch), Gill.
Sparus[8] trilineatus, . .	472	?
Sparus[9] cepedianus, . .	473	? Lutjanus, sp.

[1] "Native of the Indian and American seas. In the British Museum." (Shaw.)

[2] "Slightly described by Cépède from the MSS. of Commerson." (Shaw.)

[3] Based on "Sp. *bivittatus* Bloch, t. 263."

[4] *Sparus sciurus* Shaw, includes *Diabasis elegans* (C. & V.) J. & G. and *Serranus formosus* (L.) J. & G. *S. sciurus* may be considered as a synonym of *S. formosus*.

[5] Not *P. macrophthalmus* Cuv. and Val. = *P. arenatus* C. & V.

[6] Based on *Sparus capistratus* Gmelin.

[7] Based on *Perca palpebrosa* L.

[8] Based on *Anthias lineatus* Bloch, t. 326, f. 1.

[9] Based on *Lutjanus albo-aureus* La Cépède, iv, 239.

NAME.	PAGE.	IDENTIFICATION.
Sparus[1] sigillatus, . . .	474	?
Gomphosus variegatus, pl. 69,	480	Gomphosus varius, La Cépède.
Labrus albidus, . . .	490	Percis tetracanthus (La C.). Swain.
Labrus undulatus, . . .	496	Julis lunaris (L.), Cuv. & Val.
Labrus ballanus, . pl. 71,	498	Labrus bergylta, Ascanius.
Labrus ascanii, . . .	512	Cynædus melops (L.), Swain.
Labrus[2] carinatus, . . .	522	?
Labrus[3] cupreus, . . .	527	?
Sciæna gibbosa, . . .	539	Lutjanus gibbus, Bloch.
Holocentrus decussatus, .	557	Epinephelus[4] decussatus (Shaw), Swain.
Holocentrus japonicus, . .	565	Epinephelus[5] ruber, Bloch.
Holocentrus testudineus, .	566	Epinephelus brunneus, Bloch.
Holocentrus marginatus, .	566	Epinephelus marginalis, Bloch.
Holocentrus bicolor, . .	568	Epinephelus albofuscus (La C.), Swain.
Bodianus zebra, . . .	574	Bodianus bœnack, Bloch.
Bodianus lunulatus, . .	575	Bodianus lunaris (Forsk.), Swain.
Scomber madagascariensis, pl. 75,	590	Scombroides lysan (Forsk.), Swn.
Scomber[6] botla, . . .	591	?
Scomber leopardus, . .	591	Scomberomorus guttatus (Bl. and Sch.), Swain.
Scomber maculosus, . .	592	Scomberomorus commersonii (La C.), Swain.
Scomber[7] nigricollis, . .	597	Teuthis, sp.
Gasterosteus carolinensis, .	608	Trachynotus carolinus (L.), Gill.
Gasterosteus canadensis, .	609	Elacate canada (L.), Gill.
Mullus indicus, . . .	614	Upeneus indicus (Shaw), Günther.
Mullus bandi, . . .	615	Upeneoides vittatus, Bleeker.
Mullus[8] radiatus, . . .	618	Upeneus, sp.
Mullus aureovittatus, . .	618	Upeneus flavolineatus, C. & V.

[1] Based on *Lutjanus elliptico-flavus* La Cépède, iv, 240.

[2] Based on *Labrus aristatus* La Cépède, iii, 445.

[3] Based on *Johnius æneus* Bloch, vii, 135, taf. 357.

[4] Not identified. Based on *Epinephelus striatus* Bloch, not *Anathias striatus* Bloch, also an *Epinephelus*.

[5] Not identified by recent writers.

[6] Based on "*Botla Parah.* Russell's Indian Fishes, pl. 142 and var.? pl. 137."

[7] Based on *Centrogaster argentatus* Gmel., Syst. Nat., 1337.

[8] Not identified by recent writers.

NAME.	PAGE.	IDENTIFICATION.
Trigla[1] japonica. . . .	624	? Cephalacanthus, sp.
Genus Trachichthys, . .	630	Genus Trachichthys, Shaw.
Trachichthys australis, . .	630	Trachichthys australis, Shaw.

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NAME.	PAGE.	IDENTIFICATION.
Loricaria[2] accipenser, . .	36	Loricaria maculata, Bloch.
Loricaria dentata, . . .	37	Loricaria cataphracta, L.
Loricaria flava, . . .	38	Hypostomus plecostomus(L.), C&V.
Salmo[3] phinoc, . . .	54	? Salmo trutta, L.
Salmo salmulus, . . .	55	Salmo salar, L.
Salmo fulvus, ...	80	Sarcodaces odoë (Bloch), Günther.
Salmo rostratus, . . .	86	Coregonus oxyrhynchus, L.
Esox barracauda, . . .	105	Sphyræna picuda, Bl. & Sch.
Esox cepedianus, . pl. 110,	117	Lepidosteus tristæchus (Bl. & Sch.), J. & G.
Esox leverianus, . . .	118	Lepidosteus tristæchus (Bl. & Sch.), J. & G.
Esox stomias, . . .	120	Chauliodus sloanii, Bl. & Sch.
Polypterus niloticus, pl. 112,	122	Polypterus bichir, Geoffroy.
Mullus[4] malabaricus, . .	137	? Mugil, sp.
Polynemus niloticus, . .	151	Polynemus plebejus, Gmel.
Polynemus indicus, . . .	155	Polynemus indicus, Shaw.
Polynemus tetradactylus, .	155	Polynemus tetradactylus, Shaw.
Polynemus commersonii, . .	156	Polynemus plebejus, Gmel.
Clupea gigantea, . . .	173	Megalops cyprinoides (Brouss.), Bleeker.
Cyprinus[5] rondeletii, pl. 123,	194	Cyprinus carpio, L.
Cyprinus[6] pomeranicus, . .	202	?
Cyprinus[7] ferrugineus, pl. 131,	218	Cyprinus carpio, L.
Cyprinus punctatus, . .	220	Abramis bipunctatus (Bloch), Gün.
Cyprinus serta, . . .	232	Abramis vimba (L.), C. & V.
Cyprinus lancastriensis, . .	234	Squalius leuciscus (L.), Heckel.
Petromyzon plumbeus, . .	263	Petromyzon branchialis, L.

[1] Based on *Trigla alata*, Gmel. Syst. Nat., 1346.

[2] *Loricaria accipenser* Shaw, includes *Loricaria maculata* Bloch, and *Loricaria cataphracta* L.

[3] Based on "White Salmon, Penn., Brit. Zool."

[4] Based on "*Peddarki Sovero* Russ. pisc., t. 182."

[5] Apparently a monstrosity; based on "Rondel. aquat. 2, p. 155."

[6] Based on "*Cyprinus buggenhagii* Bloch, t. 95."

[7] Apparently a monstrosity; based on "Cyprin rouge-brun, Cépède, 6, p. 490."

NAME.	PAGE.	IDENTIFICATION.
Petromyzon bicolor,	263	Petromyzon branchialis, L.
Raja chagrinea,	281	Raja fullonica, L.
Raja fasciata,	pl. 143, 286	Myliobatis nieuhofii (Bl. & Sch.), C. & V.
Raja poecilura,	291	Pteroplatea micrura (Bl. & Sch.), Müll. & Henle.
Raja[1] diabolus,	291	? Dicerobatis giornæ (La C.), Günth.
Raja[2] maculata,	316	?
Raja[3] bicolor,	316	?
Raja thouiniana,	pl. 147, 318	Rhinobatus thouinianus (Shaw), Swain.
Raja cuvieri,	319	Raja clavata, L.
Squalus philippinus,	341	Cestracion philippi (Bl. & Schn.), Cuvier.
Squalus[4] denticulatus,	351	?
Squalus zebra,	352	Stegostoma tigrinum (L.), Günther.
Squalus semisagittatus,	361	Pristis cuspidatus, Latham.
Genus Spatularia,	362	Genus Polyodon, La Cépède.
Spatularia reticulata,	pl. 156, 362	Polyodon spathula (Walb.), J. & G.
Chimæra borealis,	pl. 157, 365	Chimæra monstrosa, L.
Chimæra australis,	pl. 158, 368	Callorhynchus australis (Shaw), Owen.
Lophius europæus,	pl. 161, 379	Lophius piscatorius, L.
Lophius cornubicus,	381	Lophius piscatorius, L.
Lophius muricatus,	pl. 162, 382	Halieutæa stellata (Walb.), C. & V.
Lophius rostratus,	pl. 163, 383	Malthe vespertilio (L.), C. & V.
Lophius[5] pictus,	pl. 165, 386	Antennarius multiocellatus (C.&V.) Günther, var. leucosoma Bleeker.
Lophius[6] marmaratus,	pl. 165, 386	Antennarius, sp.
Cyclopterus[7] pyramidatus,	pl. 167, 390	Cyclopterus lumpus, L.
Cyclopterus pavoninus,	pl. 167, 391	Cyclopterus lumpus, L.
Cyclopterus[8] bispinosus,	396	? Cotylis, sp.
Cyclopterus cornubicus,	397	Lepadogaster gouanii, La Cépède.

[1] Based on "Eereegoodee Tenkoo, Russel ind., t. 9."

[2] Based on "Temeree Russ. ind., t. 1."

[3] Based on "Nalla Temeree, Russ. ind., t. 2."

[4] Based on "Squale dentelé," La Cépède, i, 281; habitat unknown.

[5] "Pictus" is preoccupied.

[6] Not identified by recent writers; "*marmoratus*" is preoccupied.

[7] Evidently a monstrosity.

[8] Based on *Cyclopterus nudus* Gmel., Syst. Nat., 1475.

NAME.		PAGE.	IDENTIFICATION.
Balistes[1] liturosus,	. .	405	Monacanthus, sp.
Balistes sonneratii,	. .	406	Balistes bursa, Bl. & Sch.
Balistes bicolor,	. pl. 168,	407	Balistes conspicillum, Bl. & Sch.
Balistes virescens,	. .	408	Balistes viridescens, Bl. & Sch.
Balistes fasciatus,	. . .	409	Balistes rectangulus, Bl. & Sch.
Balistes unimaculatus,	. .	410	Balistes verrucosus, Bl. & Sch.
Balistes cinereus,	. . .	410	Balistes cinereus, Bonnat.
Balistes signatus,	. . .	416	Balistes fuscus, Bl. & Sch.
Balistes capistratus,	. .	417	Balistes capistratus, Shaw.
Ostracion auritus,	pl. 173,	429	Aracana aurita (Shaw), Günther.
Ostracion striatus,	. . .	430	Aracana aurita (Shaw), Günther.
Diodon[2] liturosus,	. . .	436	Diodon liturosus, Shaw.
Cephalus brevis,	. pl. 175,	437	Orthagoriscus mola (L.), Bl. Sch.
Cephalus varius,	. . .	439	Ranzania truncata (Retz), Nardo.
Cephalus pallasianus,	. .	440	Orthagoriscus mola (L.), Bl. Sch.
Syngnathus foliatus,	pl. 180,	456	Phyllopteryx foliatus (Shaw), Swainson.
Pegasus draco,	. pl. 182,	461	Pegasus draconis, Linnæus.

[1] Not identified by recent writers. "Native of the Indian seas: observed about the coasts of Otaheitee by Captain G. Tobin." (Shaw.)

[2] Based on *Diodon tachété* La Cépède, ii, 13.

DECEMBER 26, 1882.

The President, Dr. LEIDY, in the chair.

Seventy-nine persons present.

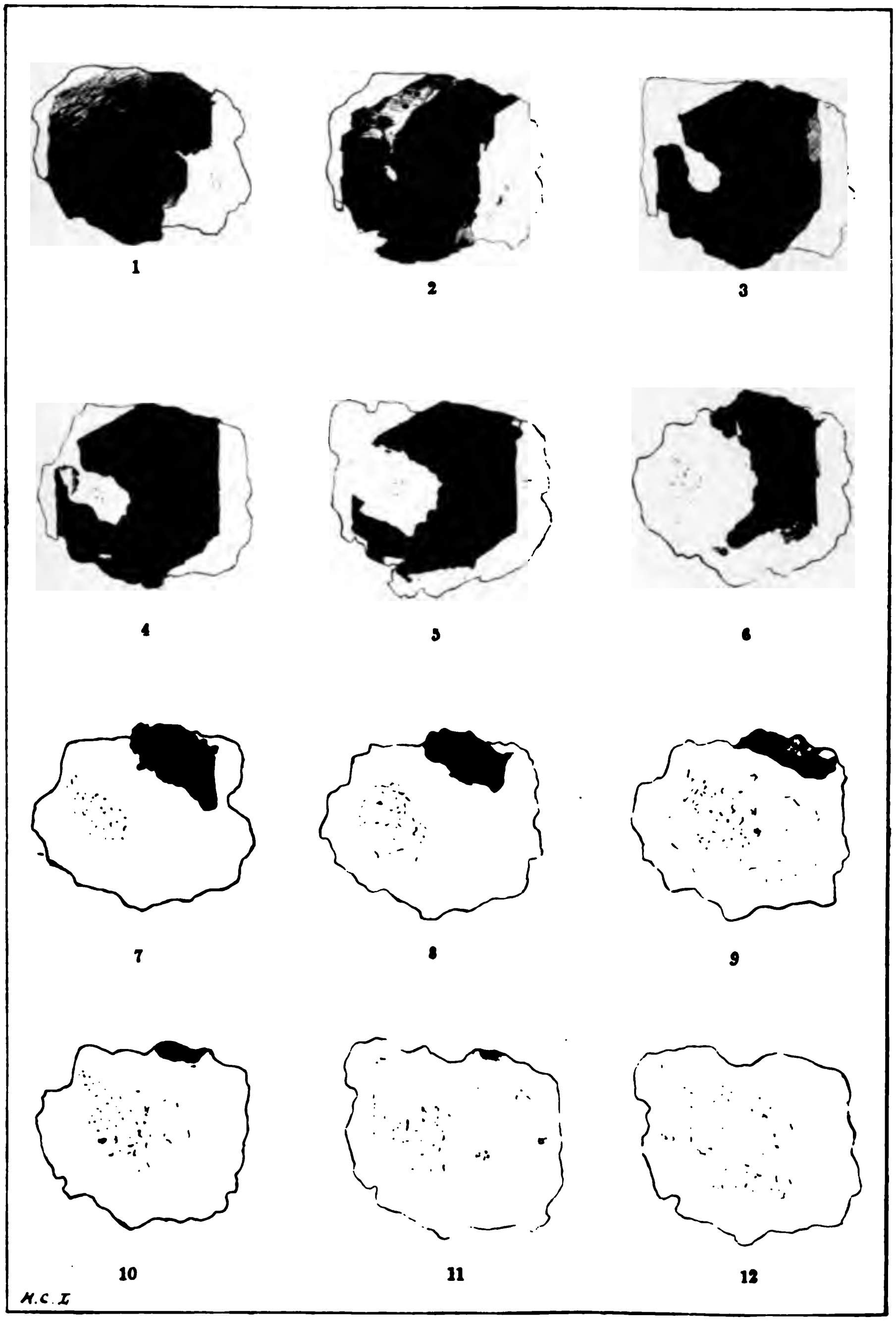
Irregularities of the Dental Arch, etc.—Dr. HARRISON ALLEN called attention to the irregularity of the front and lateral curves forming the dental arch, and to some points in connection with the hard palate. He defined the curve of the teeth placed in the front of the jaw and answering to the premaxillæ, and those placed at the sides, the latter, pertaining to the maxillæ, having been found by him to be in the jaws of civilized whites always asymmetrical.

The folds (rugæ) of the hard palate are subject to much variation. In the human fœtus of five centimetres in length, they are regular, six in number, and arranged across the palate as in certain of the lower animals. At birth they have already become irregular, but as to how far such irregularity might exist without indicating deformity, he believed no data had been collected. The names canine, first intermediate, first bicuspid, second intermediate, second bicuspid, etc., were proposed for these rugæ. They are further arranged not infrequently in a median and a lateral set, an arrangement which is strikingly exhibited in some Quadrumana. When this arrangement appears in the human subject it may be accepted as an instance of reversion.

It was thought that a study of these rugæ, since they have systemic value in Cheiroptera, Insectivora and Quadrumana, might be undertaken in connection with other anthropological data. A series of plaster impressions of the dental arches and rugæ of young and adult heads of the different races, would be found of interest in this connection.

The disposition of the form of the wisdom-tooth to occasionally simulate the form of the premolar was commented upon.

The following papers were ordered to be printed :—



LEWIS ON ENCLOSURES IN MUSCOVITE.

SOME ENCLOSURES IN MUSCOVITE.

BY H. CARVILL LEWIS.

In order to gain an insight into the method of occurrence of the crystals of biotite enclosed in muscovite, examples of which occur in several localities, the writer prepared, some seven years ago, a series of cleavage plates taken from a single crystal of muscovite and biotite. These sections, arranged in order consecutively from the base of the crystal upwards, are now delineated upon the accompanying plate, and exhibit several features of interest. The specimen figured is one of a number found at an opening in partially decomposed felspathic gneiss on Baltimore avenue, West Philadelphia. The decomposition which, due to exposure to atmospheric agencies, has more or less attacked all the minerals at this place, has either partially or completely altered the enclosed biotite into a hydrous exfoliating mineral, which, bearing the same relation to unaltered biotite as margarodite does to muscovite,[1] may be known as hydro-biotite.[2] The unaltered biotite is black, the hydro-biotite brown—both substances generally appearing in the same crystal.

The enclosed crystals of biotite have frequently well-defined edges, and contrast sharply with the surrounding white muscovite.

It is of interest to observe that, so far as noticed, the crystallographic axes of both muscovite and biotite are parallel, and their prismatic planes symmetrical. Where, owing to the imperfect development of the enclosing muscovite, this relation is not immediately perceptible, it may be rendered evident by producing in each substance a strike figure (*schlag figur*), by mechanical means. If a sharp-pointed steel rod is held lightly upon a thin piece of mica, and the rod is then struck quickly with a hammer, a hole is produced in the mica, from which radiate lines of cleavage in three directions. As Reusch has shown,[3] the cleavage in biotite (hexagonal) is parallel to the sides of the hexagon, while in

[1] *v.* Proc. Acad. Nat. Sc., Phila., 1880, p. 319.

[2] Margarodite being merely a hydrated muscovite, similar to it in all optical and physical characters, except such of the latter as are due to alteration, should properly be called *hydro-muscovite.*

[3] Monatsb. d. Konigl. Acad., Berlin, 1868, p. 428; 1869, p. 84.

muscovite (orthorhombic) two of the cleavage lines are parallel to the sides of the rhomb, and the third parallel to the shorter lateral axis (brachydiagonal). The two micas have, therefore, similar strike figures, the lines of one being parallel to those of the other. In each strike figure the lines cross each other at angles of 60°. If now a strike figure is produced close to the dividing line between the two micas, it will be seen that if the biotite is unaltered the cleavage lines run continuously from the one into the other without change of direction—a proof that the crystallographic planes of the two micas also have the same direction. This fact has already been shown by Gustav Rose[1] in a specimen of biotite in muscovite from Alstead, N. H.

Since, therefore, the two micas have symmetrically arranged prismatic planes, it is probable that they have been crystallized together out of the same solution.

A close examination of the accompanying plate, exhibiting a continuous *vertical* section of the crystal, shows that while the edges of both crystals remain parallel in successive plates, the substance of the biotite is gradually absorbed or eaten away, and replaced by the encroaching muscovite as the summit of the biotite crystal is approached. In fig. 1 the nearly perfect black crystal of biotite is seen to occupy a large space within the muscovite. Fig. 2 shows a small patch of white muscovite within the black crystal, while in figs. 3 and 4 this small patch is seen to become larger and the biotite to diminish in quantity. As the muscovite increases, the biotite diminishes. In fig. 7 the biotite is confined to one corner of the crystal. It still decreases until in fig. 11 only a minute speck of biotite remains; and finally in fig. 12 the muscovite has usurped the whole field. The biotite is apparently being eaten away by the muscovite. Both formed at once, the biotite, the more unstable of the two species, has given way to the more hardy muscovite.

Of very different character are the occasional superficial markings of magnetite, which occur upon plates of muscovite from the same locality. These markings, sometimes known as "reticulated magnetite," are most abundant and may best be studied in the muscovite of Southern Chester and Delaware Counties in Penna., and of Brandywine Hundred, Delaware.

[1] Monatsb. d. Konigl. Acad. d. Wiss., Berlin, 1869, p. 339.

These well-known and often very beautiful markings form a series of branching lines, which run in three directions across the plates of mica, sometimes resembling the frost figures upon a window pane. The lines of the figures cross each other at fixed angles of 60°, and from their similarity to crystalline forms, have been hitherto regarded by mineralogists as the result of repeated twinning around a dodecahedral axis,[1] and have been correlated with the dendritic crystallizations of native gold and copper.[2] As shown, however, by the writer in 1877,[3] these markings always bear a fixed relation to the crystallographic axes of the muscovite, and are not due to an inherent property of the magnetite.

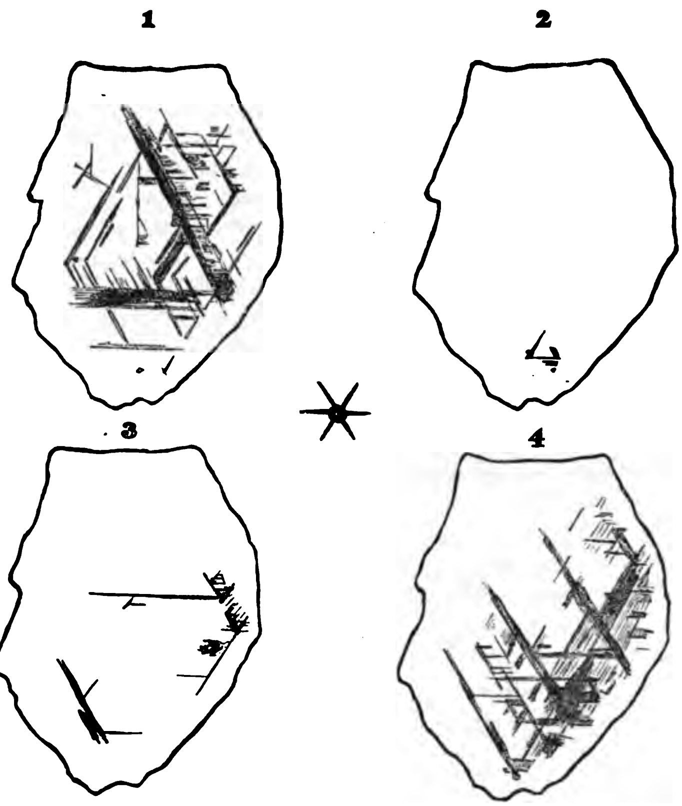
If a crystal of muscovite enclosing reticulated magnetite be dissected into a series of successive cleavage plates, it will be found that the markings throughout are confined to similar portions of the crystal and that the three directions of the lines are maintained at the same angle throughout the whole crystal. Some common cause has produced the parallelism of the lines in successive plates. On the other hand, it will be seen that there is no direct connection between any one cleavage plate and that next above or below it. One plate may be covered with markings, and the next plate entirely free from them, while the third plate will be again covered with markings, which, quite unlike the first plate in appearance and arrangement, yet form the same angles with the exterior of the crystal. Unlike the enclosed crystals of biotite, which *penetrate* the muscovite through successive plates, the reticulated magnetite is superficial, and rests upon the separate plates of muscovite in disconnected dendritic patches. The following drawing represents four successive plates of muscovite with reticulated magnetite, and shows the independence yet correlation of these markings. Lamina No. 2, which lay immediately below No. 1, is almost free from markings, while Nos. 3 and 4, cleft from the lower side of No. 2, show that the arrangement of the markings is entirely different on each lamina, although they maintain the same direction on all four. The strike figure, common to all four laminæ, is shown in the centre of the drawing. The specimen figured was obtained in Delaware, near the Pennsylvania line.

[1] J. D. Dana, System of Mineralogy, p. 150.

[2] E. S. Dana, Text book of Mineralogy, p. 93.

[3] Proc. Min. and Geol. Section, Acad. Nat. Sc., June 25, 1877.

Although always resting upon the plates of mica as very thin dendrites, the magnetite has not been derived from any external source, but evidently from the muscovite itself. The markings do not occur along lines of cracks or near the edges of the crystal, but lie in regular groups in the interior. They are not dendrites in the sense of being the result of any infiltration, and the term "dendrite" should therefore not be applied to them. They are true



"enclosures" which, like the enclosures of pyrite in calcite, or the impurities in chiastolite, are arranged with reference to the symmetry of the enclosing crystal.

This fact is rendered even more evident when the direction of the lines of the markings is compared with the "strike figures" produced artificially upon the muscovite. The writer has found

that in all cases the markings are parallel with the lines of the strike figures. In the drawing given above, the strike figure is inserted between the figures of the muscovite, and this parallelism of direction is clearly seen.

It is thus interesting to find that a blow given with a sharp instrument was necessary to bring out lines which were previously recognized and followed by the more sensitive magnetite in its growth. Just as beryls and tourmalines and quartz crystals are flattened and garnets are laminated by the enclosing mica, so the magnetite is influenced to follow the crystallographic lines of the parent mineral. Such forms might well be designated *allomorphic.* The weaker mineral is compelled into another habit by the stronger one.

It should be mentioned that occasionally the magnetite follows lines of the natural cleavage of the muscovite, such lines being at right-angles to the lines produced in the strike figure. Fig. 1, in the preceding cut, shows these secondary lines in addition to the more prominent lines which are parallel to the strike figure.

In conclusion, then, it appears that both biotite and magnetite, when enclosed in muscovite, conform in their directions to the crystallographic planes of the latter; and that while biotite penetrates through successive plates of the muscovite, and is frequently altered into it, magnetite, on the other hand, is purely superficial and forms different markings upon each lamina of mica.

ON THE VALUE OF THE "NEARCTIC" AS ONE OF THE PRIMARY ZOOLOGICAL REGIONS.

BY PROFESSOR ANGELO HEILPRIN.

The six zoological regions[1] laid down by Mr. Sclater, and so admirably sketched out by Mr. Wallace, have been so very generally accepted by naturalists that it may be considered as almost presumptuous for any one to attempt at this late hour a revision of the same. But yet the evidence concerning the position of at least one of these—the Nearctic—is in many respects so negative—indeed, it might be said so directly contradictory—that a reconsideration is rendered almost imperative. The question affecting the relationship of this region is thus stated by Wallace: "Whether the Nearctic region should be kept separate, or whether it should form part of the Palæarctic or of the Neotropical regions. Professor Huxley and Mr. Blyth advocate the former course; Mr. Andrew Murray (for mammalia) and Professor Newton (for birds) think the latter would be more natural. No doubt much is to be said for both views, but both cannot be right; and it will be shown in the latter part of this chapter that the Nearctic region is, on the whole, fully as well defined as the Palæarctic, by positive characters which differentiate it from both the adjacent regions."[2]

[1] Palæarctic, Ethiopian, Indian (Oriental of Wallace), Australian, Nearctic, and Neotropical (Austro-Columbian of Huxley).

[2] Geographical Distribution of Animals, vol. 1, p. 66, 1876. Professor Newton, in the article "Birds," contained in the Encyclopædia Britannica (9th ed., iii, p. 751, 1875), thus expresses his views in the present connection: "Thus, regarded simply from an ornithologist's point of view, what we call the Nearctic 'region,' seems to have no right to be considered one of the primary regions of the earth's surface, and to be of less importance than some of the subregions of the Neotropical region. * * * It is not, however, intended here to question the validity of the Nearctic region in a zoögeographical sense. If that position could be successfully disputed, it must be done on more than ornithological grounds, and a consideration of them would be out of place in this article. It is enough to mention that though the mammals would possibly lead to much the same conclusion as the birds do, yet the lower classes of vertebrates—reptiles, amphibians and fishes—would most likely have a contrary tendency, while the present writer is quite unable to guess at the result which would be afforded by the invertebrates."

In view of the very divergent positions occupied by the naturalists above cited as to the value of the region here referred to, it may be fairly conceded, we believe, and with due deference to the high authority of Mr. Wallace, that the question of position or relationship is still an open one; and the more especially can this be considered to be the case, since several of the authors do not appear to be agreed even as to the general (or preponderating) relationship of the contained mammalian fauna, or that branch of the representative fauna which is usually taken to be most characteristic (typical) of a region.[1]

In the hope, therefore, of throwing some additional light on this subject the author has been constrained to make the following critical inquiry. The points which it has been attempted to solve are:—

1. Whether the Nearctic region is entitled to be considered as an independent region by itself.

2. If not, of which region, Palæarctic or Neotropical, does it constitute a part.

The relative relationship of the Nearctic fauna with the faunas of the Palæarctic and Neotropical regions constitutes the first portion of the inquiry.[2]

The Nearctic mammalian fauna comprises, according to Wallace, about 26 families, as follows:

Phyllostomidæ,	Suidæ,
Vespertilionidæ,	Cervidæ,
Noctilionidæ,	Bovidæ,
Talpidæ,	Muridæ,
Soricidæ,	Dipodidæ,
Felidæ,	Saccomyidæ,

[1] Wallace, *op. cit.*, 1, p. 57.

[2] In the following analyses of mammalian families, genera and species, the author has followed the tables furnished by Wallace in his "Geographical Distribution of Animals," and for two reasons: 1st, The circumstance that these tables have served as the basis for Mr. Wallace's own conclusions, *et conseq.* as the guiding data for those authors who have accepted the views of this naturalist; and 2d, The difficulty of constructing new tables, which in their application to all the various zoögeographical regions, could claim a decided advantage over those that are here furnished. For the North American fauna a reconsideration based upon the more recent works of Coues and Allen, where the number of species is very materially reduced, is given later on.

Canidæ,	Castoridæ,
Mustelidæ,	Sciuridæ,
Procyonidæ,	Haploödontidæ,
Ursidæ,	Cercolabidæ,
Otariidæ,	Lagomyidæ,
Trichechidæ,	Leporidæ,
Phocidæ,	Didelphyidæ.

Of this number only one family—the *Haploödontidæ*—comprising one or two species of beaver-like animals inhabiting the west coast, can be said to be strictly peculiar to the region.[1] Of the 25 non-peculiar families, 19 are also Palæarctic, and of the remaining 6, 5 are exclusively Nearctic and Neotropical and 1 (*Noctilionidæ*, or short-eared bats) is found in the eastern hemisphere.

Comparing the Nearctic with the Neotropical fauna, we find that out of the 25 non-peculiar families 18 are also Neotropical, so that the relationship between the Palæarctic and the Nearctic on one side, and the Nearctic and Neotropical on the other, would appear to be equally great. But if we take the genera included in these 26 families (74 in all[2])

[1] The *Saccomyidæ*, or pouched rats, which are also regarded as peculiar to the Nearctic region by Wallace, can scarcely be considered such, since a fair proportion of the species (*Heteromys*, 6 sp. ?; *Geomys* [*Geomyidæ* of some authors]) penetrate to a considerable distance within the Neotropical region. The family is more properly *characteristic* than *peculiar*.

[2]	Number of Species.		Number of Species.
Phyllostomidæ,		Soricidæ,	
Macrotus,	1	Sorex,	16
Vespertilionidæ,		Neosorex,	1
Scotophilus,	5	Blarina,	7
Vespertilio,	6	Felidæ,	
Nycticejus,	1	Felis,	5
Lasiurus,	3	Lynx,	3
Synotus,	2	Canidæ,	
Antrozous,	1	Lupus,	6
Noctilionidæ,		Vulpes,	6
Nyctinomus,	1	Mustelidæ,	
Talpidæ,		Martes,	2
Condylura,	1	Mustela,	11
Scapanus,	2	Gulo,	1
Scalops,	3	Latax,	2
Urotrichus,	1	Enhydris,	1

we find that 35 are also Palæarctic,[1] and only 21 Neotrop-

	Number of Species.
Taxidea,	2
Mephitis,	6
Procyonidæ,	
Procyon,	2
Bassaris,	1
Ursidæ,	
Ursus,	3
Otariidæ,	
Callorhinus,	1
Zalophus,	1
Eumatopias,	1
Trichechidæ,	
Trichecus,	1
Phocidæ,	
Callocephalus,	1
Pagomys,	1
Pagophilus,	1
Halicyon,	1
Phoca,	1
Halichœrus,	1
Morunga,	1
Cystophora,	1
Suidæ,	
Dicotyles,	1
Cervidæ,	
Alces,	1
Rangifer,	2
Cervus,	6
Bovidæ,	
Bison,	1
Antilocapra,	1
Aplocerus,	1
Capra,	1
Ovibos,	1

	Number of Species.
Muridæ,	
Reithrodon,	5
Hesperomys,	16
Neotoma,	7
Sigmodon,	2
Arvicola,	27
Myodes,	3
Fiber,	1
Dipodidæ,	
Jaculus,	1
Saccomyidæ,	
Dipodomys,	5
Perognathus,	6
Thomomys,	2
Geomys,	5
Saccomys,	1
Castoridæ,	
Castor,	1
Sciuridæ,	
Sciurus,	18
Sciuropterus,	4
Tamias,	4
Spermophilus,	15
Cynomys,	2
Arctomys,	4
Haploödontidæ,	
Haploödon,	2
Cercolabidæ,	
Erethizon,	2
Lagomyidæ,	
Lagomys,	1
Leporidæ,	
Lepus,	15
Didelphyidæ,	
Didelphys,	2

In Wallace's table of the Palæarctic fauna, *Thalassarctos*, the polar bear, is considered as a distinct genus apart from *Ursus*. The Nearctic *Ursidæ* would accordingly be *Ursus*, 2 species, and *Thalassarctos*, 1 species.

[1] Vespertilio,
Urotrichus,
Sorex,
Felis,
Lynx,
Lupus,
Vulpes,
Halichœrus,
Cystophora,
Alces,
Rangifer,
Cervus,
Bison,
Capra,

ical.[1] Of these 21, moreover, 6 belong to the volant mammalia —the bats—a class of animals possessing special means for self-distribution.

It will thus be seen that *generically* the North American mammalian fauna is much more intimately related to the Eur-Asiatic than to the South American.

Furthermore, of the 35 genera also occurring in the Palæarctic region, 21 are found nowhere else but in that region—in other words, 21 out of 74 genera are peculiar to the combined Nearctic and Palæarctic regions.[2] On the contrary, of the 21 Neotropical

Martes,	Arvicola,
Mustela,	Myodes,
Gulo,	Castor,
Ursus,	Sciurus,
Callorhinus	Sciuropterus,
Zalophus,	Tamias,
Trichecus,	Spermophilus,
Callocephalus,	Arctomys,
Pagomys,	Lagomys,
Pagophilus,	Lepus.
Phoca,	

[1]

Macrotus,	Bassaris,
Scotophilus,	Dicotyles,
Vespertilio,	Cervus,
Nycticejus,	Reithrodon,
Lasiurus,	Hesperomys,
Nyctinomus,	Fiber,
Felis,	Sciurus,
Mustela,	Tamias,
Enhydris,	Lepus,
Mephitis,	Didelphys.
Procyon,	

[2]

Urotrichus,	Alces,
Lynx,	Rangifer,
Callorhinus,	Bison.
Zalophus,	Capra,
Trichecus,	Arvicola,
Callocephalus,	Myodes,
Pagomys.	Castor,
Pagophilus,	Spermophilus,
Phoca,	Arctomys,
Halichœrus,	Lagomys.
Cystophora,	

Capra has an outlying representative in the Neilgherry Hills of India, and likewise one—an ibex—in the highlands of Abyssinia.

genera occurring in the Nearctic fauna, only 11 are exclusively Neotropical. In other words, only 11 out of 74 genera are peculiar to the combined Nearctic and Neotropical regions.[1] Again, the 21 Nearctic-Palæarctic genera are represented by about 69 specific forms, whereas the 11 Nearctic-Neotropical genera have only about 39 specific representatives. So that, whichever way considered, there is a great preponderance of Palæarctic, as compared to Neotropical, forms in the Nearctic fauna. As far as the evidence afforded by the mammalia is concerned, therefore, there is a much closer relationship shown to exist between the North American (Nearctic) and Eur-Asiatic (Palæarctic) faunas than between the former and the South American (Neotropical).

It is thus manifest, that if the Nearctic fauna is not a distinct one, it should be united—if judged by its mammalian fauna alone—with the Palæarctic rather than with the Neotropical. But the question still remains, is it a distinct fauna, or is it only a lateral extension of the Palæarctic?

It has already been stated that the region possesses among 26 families of mammalia only one that is strictly peculiar to it—the *Haploödontidæ*.

The Neotropical, on the other hand, has out of about 31 families, 8 that are peculiar.[2]

The Australian, of 22, likewise 8.[3]

The Ethiopian, out of 44, 9 that are peculiar.[4]

The only other regions that can compare with the Nearctic in the paucity of their peculiar families are the Palæarctic and the Oriental, the former represented by 36 families, with not a single one peculiar, and the latter likewise with 36 families, of which

[1] Macrotus, Lasiurus, Enhydris, Mephitis, Procyon, Bassaris, Dicotyles, Reithrodon, Hesperomys, Fiber, Didelphys.

[2] *Cebidæ, Hapalidæ, Phyllostomidæ* (one species in California), *Chinchillidæ, Caviidæ, Bradypodidæ, Dasypodidæ, Myrmecophagidæ.*

[3] *Dasyuridæ, Myrmecobiidæ, Peramelidæ, Macropodidæ, Phalangistidæ, Phascolomydæ, Ornithorhynchidæ, Echidnidæ.*

[4] *Cheiromyidæ, Centetidæ, Potamogalidæ, Chrysochloridæ, Cryptoproctidæ, Protelidæ, Hippopotamidæ, Camelopardidæ, Orycteropodidæ.*

number only 3 are peculiar.[1] But the paucity of peculiar families in the case of the Palæarctic and Oriental regions is readily explained by the circumstance that both regions are bounded along the line of their greatest development by other faunal regions, with which an exchange in forms will naturally be effected. Thus the Palæarctic region is bounded along an extent of about 140 degrees of longitude, or about 9000 miles, by the Ethiopian and Oriental regions. The proportions of bounding surface to area is perhaps still greater in the case of the Oriental region. But in the case of the Nearctic region (as recognized) we have no such bounding surface—in fact we are here limited for our exchanges to the narrow strip (Mexico, Central America) uniting the two great continents—and, therefore, on the assumption of a distinct fauna it would be doubly difficult to assign a special explanation for the very limited number of peculiar families.

While the Nearctic and Palæarctic regions are each deficient in peculiar mammalian families, yet they are eminently distinguished from their nearest faunal neighbors by certain highly characteristic families, which are only rendered *non*-peculiar by the circumstance that they are contained in both regions. Such are the

1. Talpidæ, ... Moles.
2. Trichechidæ, ... Walruses.
3. Castoridæ, ... Beavers.
4. Lagomyidæ, ... Pikas.

And if the reindeer, elks, and sheep (and goats) be considered as constituting distinct families, as is maintained by many naturalists, the

5. Rangiferidæ,
6. Alcadæ,
7. Capridæ.

In addition to these 7 families we have also the hares (*Leporidæ*) and bears (*Ursidæ*), which, though not exclusively restricted to those regions, are by their numbers and vast distribution eminently characteristic of them.

Considering the Palæarctic and Nearctic regions to constitute but a single faunal division, that division would then be eminently characterized by the possession of these 7–9 peculiar families

[1] *Tarsiidæ, Galeopithecidæ, Tupaiidæ.*

alone, and would then stand in nearly the same relation by family distinctions to the other regions as the Neotropical, Ethiopian, and Australian. The combined Nearctic and Palæarctic regions would, moreover, be further united to each other by the negative character afforded in the almost total absence of the *Quadrumana*[1] and *Edentata*, orders which are abundantly represented in all the other regions but the Australian.

If now we turn to an examination of the genera peculiar to the several zoögeographical regions, we find that out of a total of 74 represented in the Nearctic, only about 26 are restricted to that region, forming 35 per cent.

In the Palæarctic, out of 100—35 peculiar = 35 per cent.
In the Oriental, out of 118—54 peculiar = 46 per cent.
In the Australian, out of 70—45 peculiar = 64 per cent.
In the Ethiopian, out of 142—90 peculiar = 63 per cent.
In the Neotropical, out of 131—103 peculiar = 78 per cent.

We here again note a deficiency in the case of the Nearctic and Palæarctic regions—an absence of positive distinguishing characters—a condition to be explained by the fact that a very considerable number of genera are rendered non-peculiar (just as in the case of the families) by the circumstance of their being represented in both the Nearctic and Palæarctic regions. But if we consider the two regions as forming in reality but one, we would have in addition to the 26 Nearctic and the 35 Palæarctic genera already referred to, 22 additional ones to be comprised in the regions as being peculiar to it, viz.:—

Genera.	Represented by Palæarctic species.	Nearctic.
Urotrichus, ...	1	1
Lyncus, ...	9	3
Gulo, ...	1	1
Thalassarctos, . . .	1	1
Zalophus, ...	1	1
Eumatopias, ...	1	1

[1] About 5 species of Quadrumana, representatives of the genera *Macacus* and *Semnopithecus*, enter within the confines of Palæarctic regions. The highest latitude in the northern hemisphere reached by this class of animals is probably the Rock of Gibraltar (Lat. 36°), inhabited by the Barbary ape (*Macacus inuus*); the genus is also represented in Japan. Three or four species of Quadrumana (*Macacus, Cynopithecus*) likewise occur in the islands Timor, Batchian, and Celebes, belonging to the Australian region.

Genera.	Represented by Palæarctic species.	Nearctic.
Trichechus,	1	1
Callocephalus,	3	1
Pagomys,	2	1
Pagophilus,	2	1
Phoca,	2	1
Halichœrus,	1	1
Cystophora,	2	2 (?)
Alces,	1	1
Tarandus,	1	2
Bison,	1	1
Cuniculus,	1	1
Myodes,	1	3
Castor,	1	1
Spermophilus,	10	15
Arctomys,	4	4
Lagomys,	10	1
	57	45

To which may also be added *Capra* (with 10 Palæarctic species), *Ovis* (with 10 Palæarctic and 1 Nearctic species), and *Arvicola* (with 21 Palæarctic and 27 Nearctic species), genera whose representatives but barely pass beyond the confines of the region—making 25 in all. We would thus have a total of about 86 peculiar genera out of 173 represented, a proportion that would stand intermediate between what we find to exist in the Oriental and Australian regions, and which would constitute about 50 per cent. The region would be accordingly eminently marked out by positive generic characters.

Turning now to a consideration of the species which represent the peculiar genera of each region—in other words, to the representative forms of the various faunas—we find that in the Nearctic region, as at present constituted, out of a total of about 279 species, the 26 peculiar genera comprise but 60, or only $21\frac{1}{2}$ per cent. of the entire fauna.

In the Palæarctic, of 426 species, the 35 peculiar genera comprise 71 = 17 per cent.

In the Oriental, of 505 species, the 54 peculiar genera comprise 165 = 33 per cent.

In the Australian, of 243 species, the 45 peculiar genera comprise 151 = 62 per cent.

In the Ethiopian, of 525 species, the 90 peculiar genera comprise 288 = 55 per cent.

In the Neotropical, of 634 species, the 103 peculiar genera comprise 376 = 60 per cent.

So here, again, just as in the case of families and genera, the Nearctic and Palæarctic regions show a very decided deficiency, the specific types that ought to characterize a fauna being but very feebly developed. But if we unite the two regions, the negative character is developed into a positive one by the incorporation of a considerable number of species representing the 25 genera, which are held in common by the two regions. The number of species held by the Nearctic region has been stated to be about 279

And of the Palæarctic, ... 426

705

Less 30 species (as will be seen further on) held in common, 30

Total for the combined region, ... 675

Of this total of 675 species for the combined region we have :—

60 represented by the genera peculiar to the Nearctic region ;
71 represented by the genera peculiar to the Palæarctic region ;
153 (171—18 common = 153) represented by the 25 peculiar genera common to the two regions ;

284

or a proportion of species representing the peculiar genera of 284 : 675 (42 per cent.), a ratio sufficiently large to impress upon the fauna a distinctive character.

In our estimates of the Nearctic fauna we have relied upon the tables furnished by Wallace. If instead of these, however, we avail ourselves of the later data furnished by the various papers of Coues and Allen, the result will not be materially altered. According to the lists furnished by these authorities it would appear that the Nearctic mammalian fauna has, instead of 279 species, only about 210.

Two new families,[1] and three new genera[2] (of which one is peculiar) are indicated.

Out of a total of 75 genera, 27 are peculiar, which would give a proportion (36 per cent.) very little different from that deduced from Wallace's data.

These 27 peculiar genera, again, are represented according to Coues' table by about 49 species, which, out of the total of 210, would give 23 per cent. of the entire fauna, or $1\frac{1}{2}$ per cent. over that which was found in our first estimation.

Again, uniting the Palæarctic and Nearctic regions with the new data, we find, instead of a total of 705 species, only 636

Deducting 30 species held in common, . . .	30
Total, ...	606

Of this total of 606 species for the combined regions we have:

71 species represented by the genera peculiar to the Palæarctic region;

49[3] species represented by the genera peculiar to the Nearctic region;

132 species (150[4]—18 = 132) represented by the 25 genera peculiar to the two regions;

252

or a proportion of species representing the peculiar genera of 252 : 606 = 42 per cent., or precisely the figure that was obtained from Wallace's tables.

The following species of North American mammalia are generally considered to be identical with Palæarctic forms, or, at any rate, to have such close Eur-Asiatic representatives as to be but doubtfully distinguishable from them:

Evotomys (Arvicola) rutilus,	Putorius erminea,
Myodes Obensis,	? Putorius vison,
Cuniculus torquatus,	Felis Canadensis,

[1] *Zapodidæ, Geomyidæ.*

[2] *Ochetodon* (*Hesperomys*, pars), *Evotomys* (*Arvicola*, pars), *Cricetodipus* (*Perognathus*, pars).

[3] Instead of the 60 before recorded, corresponding to the general reduction in the number of species.

[4] 98 Palæarctic; 52 Nearctic.

Lepus timidus,
Castor fiber,
Tamias Asiaticus,
Spermophilus empetra,
? Arctomys pruinosus,
? Urotrichus Gibbsi,
Cervus Canadensis,
Alce malchis,
Tarandus rangifer,
Gulo luscus,
? Mustela Americana,
Putorius vulgaris.

Canis occidentalis,
Vulpes vulgaris,
Ursus Americanus
(et U. horribilis ?)
Phoca vitulina,
Cystophora cristata,
Callorhinus ursinus,
Zalophus Gillespii,
Trichecus rosmarus,
Pagophilus Groënlandicus,
Halichœrus sp.

And perhaps a little less certain,

Ovis montana. Bison Americanus.

From the preceding facts it may be considered as shown, 1st, that by family, generic and specific characters, as far as the mammalia are concerned, the Nearctic and Palæarctic faunas taken collectively are more clearly defined from any or all of the other regions than either the Nearctic or Palæarctic taken individually; and 2d, that by the community of family, generic, and specific characters the Nearctic region is indisputably united to the Palæarctic, of which it only forms a lateral extension.

Evidence Afforded by the Batrachia and Reptilia.

If we now turn to the evidence afforded by the batrachians and reptiles, we will find the conclusions drawn from the study of the mammals to be strikingly confirmed.[1]

Batrachia Urodela.

The following families are enumerated in the Nearctic fauna (as usually recognized):

[1] In the following zoögeographical considerations the "Sonoran" subregion of Prof. Cope, including "parts of Nevada, New Mexico, Arizona, and Sonora in Mexico" (Bulletin U. S. National Museum, i, p. 68, 1875), is taken to represent a portion of the Neotropical region, and for reasons that will be stated further on. To this section detached from the Nearctic region will probably have to be added the peninsula of Lower California (the "Lower Californian" subregion of Cope), and portions of California and Texas.

Sirenidæ, ... Peculiar to the Nearctic.
Siren, 1 species.
Pseudobranchus, 1 sp.
Proteidæ, ... Palæarctic.
Menobranchus, 2 sp.
[Palæarctic, *Proteus.*]
Amphiumidæ, ... Peculiar to the Nearctic.
Amphiuma, 1 sp.
Muræenopsis, 1 sp.
Menopomidæ, ... Palæarctic.
Menopoma, 2 sp.
[Palæarctic, *Sieboldia.*]
Amblystomidæ, ... Palæarctic.
Amblystoma.[1]
Dicamptodon, 1 sp.
[Palæarctic, *Onichodactylus*, *Ranodon.*]
Plethodontidæ, ... Neotropical, . . Palæarctic.
7–8 genera, with about 22 species. The genus *Spelerpes*, with about 8 species, descends beyond the Nearctic boundary into northern South America; it is also represented by a solitary species in southern Europe.
Desmognathidæ, ... Peculiar to the Nearctic.
Desmognathus, 3 sp.
Pleurodelidæ, ... Palæarctic.
Diemictylus, 2 sp.

We have here, therefore, 8 families represented, 5 of which are also Palæarctic, and only one Neotropical. The 3 families restricted to the Nearctic region are represented by only 7 species. If it be urged that the presence of these 3 peculiar, but very narrowly circumscribed families is sufficient to characterize the region in which they occur, and consequently to render it distinct, it may, for similar reasons, and with almost equal force, be urged that the eastern extremity of the Eur-Asiatic region—China, Japan—should be detached from the rest of the Palæarctic by virtue of its containing representatives of two equally characteristic families, the *Menopomidæ* and *Amblystomidæ*, found nowhere else in the region.

[1] About 18 species, all of which, with one or two exceptions, are found outside of the Sonoran subregion.

Batrachia Anoura.

Bufonidæ, ... Nearly cosmopolitan.
Bufo.
Engystomidæ, . . . Tropical, Old and New World.
Engystoma, 1 species.
Hylidæ, . . . Essentially tropical, Old and New World.
Acris, 1 sp.
Chorophilus, 4 sp.
Hyla, about 12 species, several of which occur in the Sonoran region or along the Neotropical boundary.
Scaphiopidæ, ... Palæarctic.
Spea.
Scaphiopus.
Cystignathidæ, . . . Neotropical, . . Australian.
2 species, both in the Sonoran subregion.
Ranidæ, ... Essentially Old World.
Rana, 8 sp.

The above data will show that the anourous or tailless batrachians scarcely afford any positive indications as to the zoögeographical position of the region in which they occur. Yet in several respects there is a very decided leaning toward the Palæarctic. Thus it agrees with the Palæarctic in the paucity of its Bufonic element, the genus *Bufo*, which comprises about 80 species, having only about 4–5 Nearctic specific representatives (if we exclude the 6–7 species found in the Sonoran districts), and about an equal number in the Palæarctic region.

Again, in the case of the *Ranidæ*, an eminently Old World family of batrachians, we have, just as in the Palæarctic region, *only one* generic representative—*Rana*—which, with about 5–6 species, but barely penetrates within the Neotropical region. Of about 108 species comprised by the genus, 8–9 belong to the Nearctic fauna, and about an equal number, 10–11, to the Palæarctic.[1] In addition to this general similarity existing between the Nearctic and Palæarctic faunas as exemplified by the *Ranidæ*, we have the further one that at least one species of the genus *Rana*[2] is common to both regions; and another Palæarctic species

[1] Boulenger, "Catalogue of the Batrachia Salientia" of the British Museum, 2d ed., 1882.

[2] *Rana temporaria* (*R. sylvatica*).

has a closely related Nearctic representative.[1] On the other hand, in the peculiarly Neotropical or tropical (in general) groups of anourous batrachians the Nearctic province is remarkably deficient. Thus of the *Engystomidæ* we have but a solitary representative, *Engystoma Carolinense.* Of the *Cystignathidæ*, which comprises upwards of 130 Neotropical forms, we have only two[2] Nearctic species, and both of these are found just beyond the confines of the region—southern Florida and along the lower Rio Grande. There is a somewhat greater development of the genus *Hyla* of the *Hylidæ* than might have been looked for, but the genus, while it may have but one really good species, is at least represented by several very well marked varieties (variously considered to be distinct species) also in the Palæarctic region.

Ophidia.

The Nearctic serpents are comprised in 4 or 5 families—*Crotalidæ* (with about 19 species), *Colubridæ*, *Elapidæ*, *Boidæ*, and *Lichanuridæ*. The first of these being an essentially American and Oriental (!) group (a few species penetrating within the Palæarctic region), can scarcely carry much weight in the matter of zoögeographical classification. The *Elapidæ* and *Boidæ* (with 3 and 2 species respectively) are tropicopolitan, and their North American representatives but barely enter the Nearctic region. The two species of the genus *Charina* (*Boidæ*) are moreover found in that section of the United States—Nevada and Lower California—which in our estimation ought to be separated from the Nearctic region. This is likewise the case with the 3 species of *Lichanura* (Lower California), which constitute the family *Lichanuridæ*. The only and most important family that remains to be specially considered is that of the *Colubridæ*. Of this cosmopolitan family we have about 107 Nearctic species; of this number about 30 belong to genera almost exclusively restricted to the Sonoran and Californian regions. Of the remaining 77, a very large proportion (more than one-half) *belong to essentially Old World genera*—*Coluber*, *Tropidonotus* (*Eutaenia*), and *Coryphodon* (*Bascanion*)—and *principally to such as have no South American* representatives, as *Coluber* and *Tropidonotus*.[3]

[1] *Rana esculenta* in *R. halecina.*

[2] *Lithodytes Ricordii* and *Epirhexis longipes.*

[3] The range of *Tropidonotus* extends to Guatemala.

Lacertilia.

The following are the lacertilian families occurring in the Nearctic region (as recognized):—

Amphisbænidæ, ... Almost cosmopolitan.
1 species in the Florida subregion.

Anniellidæ, ... Peculiar to the Nearctic?
1 sp. in California.

Scincidæ, ... Cosmopolitan.
14 species, 13 of which belong to the Old World genus Eumeces (or *Plestiodon*).

? Lacertidæ, ... Old World.
Xantusia, 1 sp. on the Pacific coast.

Zonuridæ (*Anguidæ, pars*), ... Old World.
Opheosaurus, 1 sp.

Teidæ, ... Essentially Neotropical.
A South American family of about 12 genera and 75 species, represented in the Nearctic region by 7 species, all of which, with one or two exceptions, are confined to the Sonoran and Californian provinces.

Gerrhonotidæ, ... Neotropical.
7 sp., confined to the Sonoran, Californian and Pacific subregions, and Western Texas.

Helodermidæ.
1 sp., confined to the Sonoran subregion.

Iguanidæ,. . . . . Neotropical.
An essentially Neotropical family, with about 50 genera and 150 species. Represented in the Nearctic region by about 40 species, *all of which, with two or three exceptions*, are confined to the Sonoran and Californian regions, or but just pass beyond the limits of these.

Anolidæ, ... Neotropical.
An essentially Neotropical family, with upwards of 70 species, and with only 1 or 2 Nearctic representatives.

. . . Essentially tropical.
…resented in either the Palæarctic
…us: the 5 Nearctic species being
… Sonoran and Lower Califor-
… the extremity of the peninsula

… table shows two facts very distinctly:
… Neotropical) forms of lacertilians—
…—stop *almost immediately* on the
… sending but an extremely limited
… beyond the Sonoran subregion; and
… lacertilian forms in general throughout
… American continent. Excluding the
… provinces, and the immediate border-line
… appear to be in all *but about 20 species*
… *which belong to the Old World* genus
… diffused form of North American
… Palæarctic species![1] A further relation-
… is maintained by *Opheosaurus*, the
…ative of the "glass snakes."

Chelonia.

… Nearctic fauna to that of the Old
… by the chelonians as by any of the
… have thus far been considered. Of
…resented,[2] 3—*Trionychidæ*, *Malaclem-*
…*tively* Old World groups, and two
… *Testudinidæ*, are essentially so. One
… peculiar to the North American con-
… have one generic representative in the
… *Platysternum* be considered (as by
… family.[3]

… Japan.

… *…sternidæ*, *Emydidæ*, *Malaclemmydæ*,
…

… type of a distinct family, *Platysternidæ*, by Gray ("Sup-
… Catalogue of Shield Reptiles," p. 69, 1870).

Faunal characters defining the Sonoran and Lower Californian subregions of Prof. Cope as distinct from the Nearctic region proper, and as a portion of the Neotropical.

1. Of the 8 families of Nearctic (so-called) urodele batrachians, only 2 are represented in this portion of the continent—*Amblystomidæ* and *Plethodontidæ*—and each of these only by one or two species. Out of a total of about 54 species, therefore, this region has *only about 3!*

2. More than one-half of all the Nearctic *Bufonidæ* are found in this region, "this being the headquarters of that genus [*Bufo*] in the Regnum Nearcticum."[1] Of about 20 Nearctic representatives of the *Hylidæ* we have here but 3; and likewise only one or two of the *Ranidæ*. The Sonoran and Lower Californian tailless batrachian fauna is thus shown to be distinct by both positive and negative characters from that of the Nearctic in general.

3. The serpent fauna comprises 22 genera, of which *10–11 are peculiar*.[2] 11 out of the 13 species and subspecies of Nearctic rattlesnake (*Crotalus*) are found here, and 7 of these nowhere else. *Coluber* is not represented.

4. Of about 55 species of lacertilians, about 46 belong to the Neotropical families *Iguanidæ*, *Teidæ*, and *Gerrhonotidæ*, and 4 to the tropical *Geckotidæ*. 11 out of the 20 genera represented are not found in any other portion of the Nearctic realm, or, at any rate, at no distantly removed part.[3]

5. Only 4–5 species of non-marine *Testudinata* are recorded,[4] 2 of which (*Cinosterna*) "are of Mexican type."

Conclusion.

In conclusion it may be briefly stated that, by the community of its mammalian, batrachian and reptilian characters, the Nearctic fauna (excluding therefrom the local faunas of the Sonoran and

[1] Cope, Bull. U. S. National Museum, i, p. 74, 1875.

[2] *Gyalopium, Chionactis, Sonora, Rhinochilus, Chilopoma, Trimorphodon, Hypsiglena, Phimothyra, Chilomeniscus, Lichanura,* and *Charina* (one species of the last passes into the adjoining "Pacific" subregion).

[3] *Heloderma, Sauromalus, Uma, Coleonyx, Verticaria, Diplodactylus, Cyclura, Dipsosaurus, Callisaurus, Uta,* and *Phyllodactylus.*

[4] Up to the time of the publication of Prof. Cope's "Check List," 1875.

Lower Californian subregions, which are Neotropical[1]) is shown to be of a distinctively Old World type, and to be indissolubly linked to the Palæarctic (of which it forms only a lateral extension).

The Palæarctic (Old World) affinities are further maintained in the land and fresh-water mollusca, and not only by a considerable number of representative (identical) specific types common to both regions, circumpolar, subboreal, and otherwise, but by the presence (and extensive development in most cases) of the characteristic genera *Physa*, *Planorbis*, *Limnæa*, *Paludina*, *Vivipara*, *Valvata*, and *Bythinella*, forms not at all, or but very sparingly, represented in the Neotropical realm.[2] The *Lepidoptera* among insects carry equally strong evidence in this direction, for, as Wallace justly remarks,[3] while the Nearctic fauna embraces a number of distinct types, and the Neotropical element is sufficiently well represented in the southern United States, "still, we must acknowledge, that if we formed our conclusions from the butterflies alone, we could hardly separate the Nearctic from the Palæarctic region."[4]

[1] It is very probable that portions of California, Texas, and Florida will have to be relegated to the Neotropical realm.

[2] The very great development of the *Strepomatidæ*, or New World melanians, in the waters of the Nearctic region, might be urged as a claim for recognizing the independence of this region. But for this reason alone an equal claim might be set up for considering the eastern and western United States as constituting two distinct realms, since this group of mollusks is pretty effectually limited in its distribution by the Mississippi River, none or but very few of the forms passing west of the river, except in the region of its upper course.

[3] Geog. Distr. of Animals, ii, p. 123.

[4] It is proposed to designate the combined Nearctic (as restricted) and Palæarctic regions as the *Triarctic*, from the limitation of its fauna to the three continents bordering on the Arctic Sea. Under this acceptation the Nearctic, as hitherto recognized, completely disappears, and the Sonoran and Lower Californian subregions (to which must also be added parts of California, Texas, and Florida) of the former Nearctic become a portion of the Neotropical realm.

THE GENESIS OF THE CRYSTALLINE IRON-ORES.

BY ALEXIS A. JULIEN.

In an age which admits its special indebtedness for material advancement to the industries connected with the manufacture of iron, and in a country in which these industries have been so vastly developed as in this, the question of the origin of that metal has long possessed, and must always retain, a high degree of interest. So far as relates to the limonites, turgites and bog-ores, the question has met with a satisfactory answer in the theory of the concentration of these ores by the percolation of organic acids, as fully presented in the writings of Bischoff, Hunt and others; especially as the process can be actually observed and studied in progress in the lakes, marshes and bogs of the present day. But the mode of genesis of the crystalline ores—hematites, magnetites, menaccanites, and their mixtures—enveloped partly in the sedimentary strata and chiefly in the still more ancient crystalline rocks of archæan age, can be only inferred from analogies. Nor can the problem be considered as solved by any or all of the numerous theories which have so far been advanced. These theories may be naturally divided into two classes, as they may refer the iron-ores, enclosed in the subterranean strata, to an extraneous or to an indigenous origin.

A. Theories of Extraneous Origin.

To begin with the former, we have

1. *Meteoric fall.* This startling theory has been suggested to account for the enormous mass of martitic specular iron-ore, claimed to be the most extensive known single deposit of iron-ore on the continent, that of the Cerro de Mercado, two miles from Durango, Mexico. "Cerro de Mercado is a mountain, one mile long, one-third of a mile wide, and from 400 to 600 feet in height. The ore-surface of the mountain aggregates over 10,000,000 square feet; but there are indications that the ore is not all above ground, and the engineer's report declares it to be an enormous aërolite, half imbedded in the level plain on which it lies." Such a view is sufficiently controverted by the mineralogical constitution of

the mass, and its structure—"immense veins of specular iron-ore standing nearly vertical."[1]

2. *Eruption as dykes.* According to this genetic view, the crystalline iron-ores have been extruded from the interior in a pasty condition, like a lava, through fissures in the superficial strata.[2] This theory has been recently further developed in reference to the banded jaspery iron-ores of Michigan, and it has been advanced that the banding and lamination of these ores are similar in character and origin to those strongly marked in rhyolytes, furnace slags, etc.[3] The mineralogical constitution and infusibility of these ores, their distinctly sedimentary lamination, etc.,[4] clearly testify to the unsoundness of these hypotheses.

3. *Sublimation into fissures.* The inconsiderable crusts of specular oxide, which have been observed in the vicinity of volcanoes, such as Vesuvius, have certainly no relation to the enormous *bedded* masses, distributed throughout the world, at a distance from volcanic centres.

B. Theories of Indigenous Origin.

The theories of this class differ in ascribing the origin of iron-ores to either chemical or mechanical agencies. Nine chemical theories have been proposed.

4. *Concentration from ferriferous rocks or lean ores*, by the solution and removal of the predominant constituent, *e. g.*, silica, by means of thermal solutions. Indeed it has been shown[5] that a concentration, in a similar way, of the ferriferous constituent, in the lower carboniferous limestone and dolomites of the Mississippi basin, through the removal of the more soluble calcium carbonate by carbonated waters, has apparently produced extensive deposits of limonite, *in loco originali*. But there is no evidence

[1] B. Silliman, Am. Jour. Sci., 1882 (iii), xxiv, 375; and J. Birkinbine, Chicago Min. Jour., 1882, ii, No. 4, p. 184.

[2] J. D. Whitney, The Metallic Wealth of the U. S., p. 433.

[3] M. E. Wadsworth, Proc. Bost. Soc. Nat. Hist., 1880, xx, 470; and Am. Jour. Sci., 1881 (iii), xxii, 403.

[4] J. D. Dana, Am. Jour. Sci., 1881 (iii), xxii, 320, 402; J. S. Newberry, Sch. of Mines Quarterly, Nov., 1880.

[5] J. P. Lesley, Report on Brown Hematite Deposits of Nittany Valley, Pa.; R. Pumpelly, Geol. Surv. Mo., Prelim. Rep. on Iron-ores, 1872, 8, *et seq.*

of the relation of any of the crystalline iron-ores, enclosed in sediments of plainly submarine origin, with any such subaërial process. Even were the theory satisfactory in regard to the pure ores, the essential question remains unanswered, viz., the genesis of the original "ferriferous rocks or lean ores" themselves.

5. *Saturation of porous strata, e. g.*, of sandstone, by infiltrating solutions carrying iron oxide.[1] This theory, however applicable to certain rock-masses rich in hydrated ferric oxides, can account neither for the concentration of the huge and pure bodies of the true ores, nor for the alternation of siliceous and ferriferous laminæ and layers in the lean ores.

6. *Infiltration into subterranean chambers and channels*, depositing pipe-ores and limonites in widened crevices and joints of the more recent limestones or other sedimentary rocks, or in cavities overlying impervious strata.[2] The lenticular form, laminated structure, intercalation of the material of the matrix, enclosure of the ore-bodies in the bedding-planes, and other facts, markedly distinguish the crystalline ores from the limonites formed by such a process.

7. *Decomposition of pyrite*, and other ferruginous minerals, enclosed in decaying schists, and transfer of the iron-oxide in solution as ferrous sulphate.[3] The precipitation of the iron-oxide has been sometimes attributed to simple oxidation, more usually to the production of ferrous carbonate, by reaction between the ferrous sulphate and the calcium carbonate of the limestone, afterwards converted into limonite by oxidation and hydration.[4] This theory has had only local application, even to the limonites, and its connection with the crystalline ores is rendered improbable by the absence of associated limestones, or, if present, of evidences of their erosion, etc.

8. *Derivation from original deep-sea deposits* of hydrous ferric oxide, or of ferrous carbonate, dehydrated by subsequent heat, and deoxidized by hydrogen.[5] By a modification of this theory, the jasper-ores have been connected with the ferruginous and mangan-

[1] Emmons, Nat. Hist. N. Y., iv, 94.

[2] F. Prime, Jr., Am. Jour. Sci., 1875 (iii), ix, 433.

[3] T. S. Hunt, Nat. Ac. Sci., Nov., 1874.

[4] G. Bischoff, Chem. and Phys. Geol., i, 236; F. Prime, Jr., *loc. cit.*; W. B. Rogers, Geol. Penn., 1868, ii, Pt. ii, 722, 729.

[5] J. P. Lesley, The Iron Master's Guide, p. 374.

iferous nodules which have been dredged from the surface-layer of the deep-sea ooze of our present ocean-bottoms.[1] All the evidence so far gathered, however, shows no correspondence between the phenomena, the ferriferous contents of the ooze consisting of irregular crusts and nodules, never continuous nor interlaminated with silica. On the other hand, there is abundant evidence that the strata associated with the crystalline iron-ores are mostly shallow-water or shore-deposits, in large part conglomeritic.

9. *Deposit from springs*, by oxidation and precipitation from solutions of ferrous carbonate, on exposure to the air at their issue.[2] Such deposits, it is admitted, are local and limited, and the theory can have no bearing on the ordinary wide-spread crystalline ores.

10. *Alteration of diffused ferric oxide*, disseminated through sediments, into ferrous carbonate, in presence of vegetable matter, and its accumulation in particular layers by processes of filtration and segregation.[3] The vague processes thus invoked to account for the accumulation of ores are not accepted as satisfactory, even for the carbonates of the coal measures, lying in definite planes. Nor do the sheets and beds of crystalline ores usually show the irregular characteristics which may be attributed to processes of segregation.

11. *Metamorphism of ancient bog-ores.* The reference of the crystalline iron-ores to this origin has been thus stated by Dr. Hunt: "I see no reason for assigning any other than a sedimentary origin to the magnetic and specular iron-ores of the crystalline schists; nor do I conceive that the conditions under which they were deposited differed essentially from those which at the present day give rise to beds of limonite and ochre."[4] Again he observes: "The organic matters reduce the peroxide of iron to a soluble protoxide, and remove it from the soil, to be afterwards deposited in the forms of iron-ochre and iron-ores, which by subsequent alteration become hard, crystalline, and insoluble."[5]

[1] W. O. Crosby, Proc. Bost. Soc. Nat. Hist., 1879, xx, 168,

[2] G. Bischoff, Chem. and Phys. Geol., i, 155-157, 166-167.

[3] W. B. Rogers, Geol. Penn., 1868, ii, Pt. ii, 737.

[4] Letter of Dr. T. S. Hunt, 1858, quoted in Lesley's Iron Master's Guide, p. 865. See also Vanuxem, Nat. Hist. N. Y., Geol., 3d District, p. 267.

[5] T. S. Hunt, Chem. and Geol. Essays, 22.

Le Conte also states: "Therefore we conclude that both *now* and *always* iron-ore is, and has been, accumulated by organic agency."[1]

Prof. J. D. Dana remarks,[2] concerning the Upper Silurian deposits: "The beds of argillaceous iron-ore * * * could not have been formed in an open sea, for clayey iron deposits do not accumulate under such circumstances. They are proof of extensive marshes, and, therefore, of land near the sea-level. The fragments of crinoids and shells found in these beds are evidence that they were, in part at least, salt-water marshes, and that the tides sometimes reached them." In reference to the Laurentian deposits, he states: "Limestone strata occurred among the alternations, and argillaceous iron-ores, though vastly more extensive. * * * The argillaceous iron-ore has become the bright hematite or magnetite, and it is banded by, or alternates with, schist and quartz, etc., which were once accompanying clay- and sand-layers."

Dr. Kitchell long ago opposed the theory of the igneous or eruptive origin of the magnetic iron-ores of New Jersey, maintaining that they "were of sedimentary origin, and had been deposited just as the gneiss and crystalline limestone had."[3] With this view Prof. Cook coincides, in the following statement: "The magnetic iron-ores of this State have originated from chemical or mechanical deposits, just as our hematites and bog iron-ores do now."[4]

In opposition to this theory, in its reference to subaërial bogs or marshes, it must be considered that the enclosing and associated strata bear universal testimony, both in their contents and the form of their superficies, to their submarine mode of deposit. On the other hand, if the bog-ore theory were applicable to these ores, every ore-bed would imply a terrestrial plane for the reception of the subaërial bog deposit, *i. e.*, for every ore-lens a corresponding elevation above the sea-level and ensuing subsidence of the entire underlying stratum. On the contrary, no evidence has been shown in the archæan strata of any subaërial surface; all appear to be submarine sediments, and that still more ancient rocky terrane which formed the coast whose débris, poor in iron,

[1] J. Le Conte, Elements of Geology, 375.

[2] J. D. Dana, Manual of Geol., p. 231 and 155.

[3] W. Kitchell, Geol. Surv. N. J., 2d Rep., 1855, 155, 229, etc.; and 3d Rep., 1856.

[4] G. H. Cook, Geol. of N. J., 1863, 61.

was deposited or strewn over the ancient Laurentian sea, and upon whose surface bog-deposits may have rested, seems to have been entirely buried up beneath later sediments. Again, the strongly marked lenticular form and laminated structure of all deposits of crystalline iron-ores—and even of the numerous smaller lenses, parallel or overlapping, which make up the large deposits—are unmistakably characteristic of marine accumulation, Neptune's own royal stamp. A bog-ore deposit is almost always irregular in outline, concretionary and cavernous in structure, and commonly characterized by concentration in pockets and groups of isolated lumps. One can rarely fancy any traces of such peculiarities in the compact symmetrical lenses which make up ordinary deposits of magnetite.

The complete dehydration and partial deoxidation of the hydrated iron-oxide of a bog-ore, necessary for its conversion into a magnetite, must have produced an enormous contraction; but of this there is rarely any evidence, such as might be expected, in the disturbance of the lamination of the ore, and of the stratification of the surrounding rock.

It is of common occurrence that a bed of crystalline iron-ore overlies a bed of limestone, in immediate contact (*e. g.*, at the Baldwin-Forsyth mine, Hull, Canada); and yet the surface of the latter is perfectly plane, presenting no trace of the pitting and erosion[1] to which so soluble a material would have been subjected by the action of the organic acids supposed to have been concerned in the concentration of the ore in a bog.

Although graphite does often occur in intermixture with the crystalline ores, its general absence seems to prove that it cannot be chiefly derived from the organic matter (1 to 36 per cent.) contained in all limonites, but rather, it may be, from the algæ and marine plants sometimes finding their growth and entombment in the sands, even of iron-oxide, in shallow water. To the deoxidation produced in the decomposition of the remains of such plants, the content of sulphur in many iron-ores may be due.

12. *The metamorphism of ancient lake-deposits* of limonite passing into hematite, corresponding to the oolitic " fossil ore " of the Clinton group of the Upper Silurian, to the " mustard seed " ore described by Sjörmalm, which is deposited near the banks of

[1] B. Von Cotta, Ore Deposits, 249, 284.

the present Swedish lakes,[1] etc. This "Lake ore" theory[2] seems to be valid for a large number of huge deposits of the crystalline ores, and also satisfactorily accounts for the abundant presence of apatite in many ore-beds. It may be fittingly applied, therefore, in explanation of the phenomena seen in those deposits which contain a notable amount of calcium phosphate; most of those which consist of hematite, or of magnetite passing into or occasionally enclosing hematite, viz., in this country those of Cerro de Mercado, of Southern Utah, of Port Henry, N. Y., etc.; and the beds of magnetite which present the botryoidal and concretionary aspect and radiated structure of limonite, *e. g.*, in Southern Utah.[3]

On the other hand, the poverty or almost entire absence of phosphorus and sulphur in certain ore-beds, and the extreme abundance of titanic acid, free alumina, garnet, olivine, etc., in others, demand some other explanation.

Two mechanical theories are yet to be considered.

13. *Violent abrasion and transport.* This theory may be best stated in the words of its author:

"That the azoic period was one of long-continued and violent action cannot be doubted, and while the deposition of the stratified beds was going on, volcanic agencies, combined with powerful currents, may have abraded and swept away portions of the erupted, ferriferous masses, re-arranging their particles and depositing them again in the depressions of the strata."[4]

This theory of Whitney was supplementary to his main theory of volcanic eruption of the ferriferous masses, rich in native iron. But to this Lesley properly objects that such secondary deposits would be conglomeritic and also contain metallic iron.

14. *Concentration and metamorphism of iron-sands.* The work of the ocean as a grand abrading agent, and in the transport of the abraded detritus, has been largely studied and described by many authors; but less attention has been paid to the action which goes on, during the shorter or longer period of transport

[1] B. Von Cotta, Ore Deposits, 461; The Geologist, 1863, 36.

[2] Dr. J. S. Newberry, "The Genesis of Our Iron Ores," Sch. of Mines Quarterly, Nov., 1880, and "On the Genesis of Crystalline Iron-Ores," Trans. N. Y. Acad. Sci., vol. ii, Oct. 23, 1882.

[3] J. S. Newberry, *loc. cit.*, 12.

[4] J. D. Whitney, Met. Wealth of the U. S., 434.

of the detritus, in sorting out the various constituents in reference to specific gravity. Almost every sheltered bay and cove afford instances, not only of local deposits peculiar as to size, *e. g.*, gravels, sands, or fine silt, but concentrated gatherings of the grains of certain minerals, whose separation has been due to the relation of their specific gravity and form to the force of the surf or of local currents. The tertiary sands which border our Atlantic coast present everywhere examples of this continuous and delicate jigging action of the ocean, in the gathering together—now of black iron-sands, either magnetic or titaniferous, now of red garnet-sands, often of the two intermingled, and, still more abundantly, deposits of pure white quartz-sand. The iron-sands become very prominent in certain localities, *e. g.*, in this country at Killingsworth, on the Connecticut shore of Long Island Sound, on the north shore of the lower St. Lawrence, on the coasts of California and the shores of Lake Huron and Lake Erie, Oregon, etc., and abroad, along the coast of Great Britain, the shores of the Baltic and Mediterranean, New Zealand, Madagascar, and Hindostan. Special attention has been given to the deposits of the lower St. Lawrence, which lie about three metres above high-water mark, and comprise layers of black iron-sand, often nearly pure, from 1·5 to 15 centimetres in thickness.

"An inspection of the iron-sands, from the various localities above mentioned, shows that they all contain, besides the ores of iron, a small proportion of red garnet, and more or less of fine siliceous sand. The latter of the two substances it is possible to remove almost entirely by careful washing of the crude ore."[1]

The frequent purity of these sands may be inferred from the following determinations by Dr. Hunt of their content of *quartz and siliceous residue:*

Rivière du Loup (in Chaudière Valley),	4·80	per cent.
Moisie,[2]	5·92	"
Quogue. Long Isd., N. Y. (quartz and red garnet), ...	17·00	"

In other parts of the world, especially where volcanic or crystalline rocks compose the coast-line, other minerals, such as olivine

[1] Dr. T. S. Hunt, Rep. Prog. Geol. Can., 1866-69, 261-269; also, Canad. Nat., 1872, vi, 79.

[2] The washed iron-sand contains 0·70 per cent. of sulphur, and 0·007 per cent. of phosphorus.

(in the Sandwich Islands), hornblende, augite, volcanic glass etc. (on the Mediterranean), often constitute the sands along the shores. Beach-sands, where non-calcareous, consist chiefly of the following minerals,[1] which are arranged in the order of their specific gravities:

	S. G.
Quartz (and chert),	2·5—2·8
Olivine,	3·3—3·5
Garnet,	3·1—4·3
Chromite,	4·3—4·6
Menaccanite,	4·5—5·
Magnetite,	5· —5·1

It is a significant fact that in the metamorphic, crystalline rocks of our continent, from Canada to Alabama, we find the same minerals concentrated also in rock-form, viz.:

Quartzite (siliceous schist, jasper, etc.): common everywhere.

Chrysolite (or dunite. Largely converted into serpentine, etc.): Canada, Michigan, North Carolina, Georgia, Alabama, etc.

Garnetite (or garnet-rock. Sometimes made up of manganese-garnet): Canada, New York, North Carolina, etc.; in close association with magnetite at Franklin and near Andover, N. J., in Grenville, Canada, etc. Doubtless in some cases the origin of this mineral (as well as of olivine), especially if crystallized, must be assigned to indigenous development in the course of metamorphism. But, at the Buckhorn Mine, Harnett County, N. C., my own examination of the section, 61 metres in height, confirms the statement of Prof. Kerr,[2] who notes the following series (from above downward):

Specular ore (11 metres).
Manganesian ore.
Slaty manganese-garnet.
Feldspathic gneiss.
Manganese-garnet.
Gneiss.

[1] In regard to pyrite, its ready decomposition has usually prevented its concentration in sands. As to hematite, its foliated texture seems to have resulted both in its wide transport and distribution, resisting concentration, and in its after conversion into hydrated peroxide.

[2] Geol. N. C., 1875, 1, 222.

Here the garnet certainly occurs in ancient sedimentary layers, whose partial decomposition has saturated the ore with manganese oxide; while the small admixture of magnetite, frequently dispersed through the hematite, points to the original sediment of iron-sand.

Chromite: Massachusetts, Pennsylvania, North Carolina, etc.

Menaccanite: Canada, New York, New Jersey, Pennsylvania, etc.

Magnetite: common everywhere.

Compound varieties also occur in abundance, which correspond closely to the mixtures of the same minerals in the sands along the coast, viz.:

Magnetic quartzite (martitic and hematitic jasper-schists, etc.): common everywhere.

Magnetitic garnetite (also hematitic and *manganesian*): Buckhorn Mine, N. C.

Chromitic dunite: Canada, North Carolina, Alabama, etc.

Chrysolitic menaccanite (with magnetite): Cumberland, R. I.[1]

Chrysolitic magnetite: O'Neil Mine, Monroe, Orange County, N. Y.[2]

Garnetiferous magnetite: mines in Saratoga and Washington Counties, N. Y., etc.

Similar allied rocks occur abundantly in foreign countries: dunite and chrysolitic rocks in Europe, New Zealand, etc.; chrysolitic magnetite, at Taberg, Sweden;[3] magnetite and menaccanite, in many localities.

Garnet, together with hornblende, augite, cassiterite, apatite, etc., has been observed in admixture with the magnetites of many foreign deposits, *e. g.*, of the Thorbjörnsbo mine at Arendal, Sweden; of Traversella, in Piedmont; of Berggieshübel, in Saxony; of Schmiedeberg, in Silesia, etc. F. Wöhler relates:

"We spent a day in the large iron-mines of Langbanshytta. The gangue of the fine magnetic iron-ore is frequently brown

[1] M. E. Wadsworth, Bull. Mus. Comp. Zool., 1881, vii, 183.

[2] J. D. Dana, Am. Jour. Sci, 1881 (iii), xxii, 152.

[3] A. Sjögren, Neues Jahrb. für Min., 1876, 434.

garnet, which is found in large quantities at the mouth of the mine, and often serves as flux for the reduction of the ore."[1]

As the rock-strata, associated with all these varieties, are undoubtedly of marine origin, and indicate deposition in shallow water, it is natural to infer their correspondence in origin, in many cases, with the unconsolidated shore-deposits of the present day. In a recent search through the scientific literature of the subject for any similar view, the following statement was found concerning the crystalline iron-ores of Canada, in which this theory has been, with some reserve, associated with the bog-ore theory:

"It seems possible that, in some cases, beds may have been formed by the accumulation of iron-sands, just as they are forming in the Gulf of St. Lawrence to-day, the material being derived from the disintegration of pre-existing crystalline rocks. Such beds we should expect to contain, not only magnetite, but ilmenite, and it is well known that in many cases, ores, on being pulverized, may be more or less completely separated into a magnetic portion, containing little or no titanic acid, and a non-magnetic portion consisting essentially of ilmenite. It seems, however, probable that in general their origin has been similar to that of the modern bog- and lake-ores. Deposits of magnetite, as a rule, do not continue of uniform thickness for any great distance like the enclosing rocks; and this is just what might be expected if we suppose them to have originally occurred as bog- or lake-ores, which accumulated in local hollows or depressions."[2]

The thinly laminated martitic and hematitic jasper-schists of the Huronian age, always remarkably free from both sulphur and calcium-phosphate, at once present themselves for explanation. Prof. Dana, in a criticism on other views,[3] has attributed the origin of these iron-ores to "metamorphism from original marsh-made beds." More probably, in my opinion, the conditions consisted of a shore of some quartzose rock, rich in magnetite, whose débris the waves and currents strewed over the sea-bottom, alternately with thin sheets of quartz-granules and magnetite-crystals, partially concentrating the one or the other material in numerous heaps or thicker layers. In the progress of the metamorphism and contortion

[1] F. Wöhler, Early Recollections of a Chemist, Am. Chem., 1875, vi, 131.

[2] B. J. Harrington, Geol. Surv. Canada, Rep. Prog., 1873-1874, 195.

[3] Am. Jour Sci., 1881 (iii), xxii, 402.

to which the layers were subjected, their compact and lenticular forms were further developed, the magnetic oxide was further oxidized, partially as martite, or completely as specular ore (as already suggested by Brooks, Credner, and others), and assumed, at points where the contortion and pressure became intense, the micaceous structure and brilliant lustre of micaceous iron-ore, by a process similar to that which produces "slickensides."

The concentration of nearly pure magnetite in the deposits enclosed in the Lower Laurentian strata of Canada and the Adirondacks, and of titaniferous magnetite or menaccanite in the huge ore-beds associated with the anorthosites of the Upper Laurentian in both regions, point unmistakably to mechanical separation of ferriferous sediments from different terranes: *i. e.*, in the one case from the magnetitic gneiss, in the other from the traps and anorthosites, rich in menaccanite. An examination of thin sections of diabase from dykes cutting pure magnetites in Essex County, N. Y., showed this rock to be rich in menaccanite and a possible source of such sediments.

No concentration of titanic acid has ever been found in limonites or bog-ores. These facts seem significant of the insufficiency of any chemical theory to account for the origin of all the iron-ores.

In conclusion, it may be inferred that the mode of genesis of a bed of magnetic iron-ore may be determined with some probability by the following diagnosis.

When the ore retains structural characteristics allied to those of limonite, or encloses masses of hematite, or contains a notable amount of calcium-phosphate, a chemico-organic origin is probably indicated.

When the ore is exceptionally free from phosphorus, or is rich in titanic or chromic acid, or is closely associated or mixed with granular garnet or olivine, a mechanical origin may be inferred

The following annual reports were read and referred to the Publication Committee:—

REPORT OF THE RECORDING SECRETARY.

The Recording Secretary respectfully reports that during the year ending Nov. 30, 1882, fifteen members and six correspondents have been elected.

The Council has endeavored to recommend for election as correspondent those only who deserve such recognition of their scientific standing, or who, as collectors and contributors, may confer material benefit on the society.

Resignations of membership have been received from Ferris W. Price, T. L. Buckingham, T. Miles, H. W. Stelwagon and Henry Leffman. The name of one member-elect was ordered to be stricken from the roll in consequence of the provisions of the By-Laws not having been complied with within the prescribed time.

The deaths of twenty-one members and eleven correspondents have been announced. The names of the deceased have been recorded in the printed Proceedings, under the several dates of announcement.

Twenty-two papers have been presented for publication, as follows: Angelo Heilprin, 3; Rev. Dr. H. C. McCook, 2; Theodore D. Rand, 2; Henry S. Williams, 1; Dr. W. S. W. Ruschenberger, 1; L. T. Day, 1; Aubrey H. Smith, 1; Rafael Arango, 1; Dr. Harrison Allen, 1; J. S. Newberry, 1; Charles Mohr, 1; T. W. Eastlake, 1; R. E. C. Stearns, 1; Dr. Joseph Leidy, 1; Drs. H. C. Wood and H. F. Formad, 1; Joseph Swain, 1; H. A. Keller, 1; E. S. Reinhold, 1. These include four papers which were presented through the Mineralogical Section and published as part of its Proceedings. The paper by Drs. Wood and Formad, on Diphtheria, was withdrawn by the authors; all the others have been printed.

One hundred and fifty-two pages of the Proceedings for 1881, and two hundred and forty-eight for 1882, together with six lithographic plates, have been published.

Some of the earlier numbers of the publications having been entirely exhausted, it was found necessary to reprint 75 pages and three plates of the quarto Journal and 38 pages of the Proceedings. The Publication Committee is greatly indebted to Mr. Chas. F. Parker, who has devoted much care to the arrange-

ment of our stock of the earlier publications. Apart from frequent errors of paging and numbering of signatures, no account had been taken of stock on hand since the removal of the society to the present building, and it required one of Mr. Parker's experience in such work to determine how far sets of the first ten volumes of the Proceedings could be completed. The result has been an unusually large return from sales of back numbers and complete sets, as may be seen by reference to the report of the Treasurer. It will, however, require considerable additional outlay for reprinting, to enable the Committee to fill orders for the first series of the Proceedings. The scarcer numbers and volumes have not, of course, been sold separately.

One hundred and twenty-five copies of the Proceedings have been distributed to subscribers, and three hundred and forty to foreign and domestic exchanges. Of the latter, seventy-six have been sent by mail, and two hundred and sixty-four have been distributed by the Smithsonian Institution and its system of international agencies.

The average attendance at the weekly meetings, which have been held without interruption, has been twenty-six. Verbal communications have been made by thirty-two individuals, and the majority of them have been published in the Proceedings. So well has the interest in these meetings been sustained, that it has been found desirable to report forty-three of them, or all but nine, and these for the most part held in midsummer, for the public papers. In addition to the regular meetings of the Academy, those of the Sections have been held with the results recorded in the several reports.

The By-Laws were amended as follows :—Art. 14, Chap. V, by striking out all after the word " meetings," in the third line, and inserting " and with like approval may change the same." Art. 4, Chap. V, by adding " But Sections may admit persons not members of the Academy to be contributors under such rules and on such terms as the Section may determine, always provided, that a contributor shall not be eligible to office in a Section, or to vote on any question; and also provided that the rights and privileges of a contributor shall be restricted to attendance at the meetings of the Section, to the reading of original scientific papers and to taking part in the scientific discussions and proceedings exclusively, and that a contributor shall have no other right or privilege whatever in the Academy."

A proposition to so amend Art. 1, Chapter XI, as to prevent the loaning of type specimens from the Museum, was, on the recommendation of the Council, lost, it being the opinion of the majority that sufficient guarantee for their care and preservation already existed in the laws governing the loaning of specimens.

On April 25, Dr. Chas. Schaeffer was elected a Curator to supply the vacancy caused by the death of Dr. Kenderdine. He held the position until Oct. 31, when he resigned in consequence of a proposed continued absence from the country. As the vacancy occurred so near the end of the year, it was not deemed necessary to fill it until the casting of the annual ballot, which resulted in the election of Dr. W. S. W. Ruschenberger, together with the three Curators who had held office during the year.

The death of Mr. Wm. S. Vaux left vacant a Vice-Presidency and a Curatorship. On May 23 the Rev. Dr. Henry C. McCook was elected to the former office and Mr. Jacob Binder to the latter. Mr. Thos. A. Robinson was elected to fill the vacancy in the Council, caused by the election of Rev. Dr. McCook as Vice-President, he thereby becoming an ex-officio member of the Council.

At the meeting held May 23 a letter was read from a friend of the Academy, presenting through Mr. Jos. Jeanes the sum of one thousand dollars, to be appropriated in such manner as Mr. Jeanes might think best for the interests of the society. It having been suggested by Mr. Jeanes that the money might with advantage be made the nucleus of a Museum Fund, this disposition of the gift was ordered, and the meeting held May 30, adopted the following resolutions, placing the creation of the Fund on formal record:—

Inasmuch as the Academy has determined to appropriate towards the creation of a Museum Fund, one thousand dollars which have been received from "a friend of the Academy," whose name is withheld at his request, through the kindly hands of Mr. Jeanes:—

Resolved, That the Museum Fund thus begun be held under the provisions of the By-laws, Chap. VI, like other special funds.

That Mr. Jeanes be requested to convey to our liberal friend the thanks of the Academy for his bounty and generous token of friendliness to scientific work.

The Museum of the Academy, in some respects one of the

finest in the world, has grown almost entirely by gifts from those interested in the progress of the natural sciences. The Curators have never until now had even the smallest annual sum placed at their disposal for the purchase of desiderata, and many opportunities, therefore, of obtaining such have been lost. Several of the departments of the Museum are now so large that a comparatively small outlay will be sufficient to keep them abreast of current investigation. The value of a museum depends, not so much upon its size as upon the care taken by competent persons in the selection of the objects composing it.

Thanks to the liberality of Mr. Isaiah V. Williamson, Mr. Jos. Jeanes and the late Dr. Thomas B. Wilson, the Academy is reasonably well supplied with current scientific literature, but such fresh collections as have been studied from time to time by those connected with the society, either as members or students, have been for the most part secured by individual enterprise. It is hoped that the Museum Fund now created will be so added to as to furnish the means of procuring for the society material for original research.

At the meeting held Sept. 12, a committee, consisting of Messrs. Ruschenberger, Redfield, Tryon, McCook and Meehan, was appointed for the purpose of determining means for the extension of the building.

In harmony with a suggestion made by Dr. Horatio C. Wood, during a communication to the Academy, Oct. 10, on the source of supply of the cinchona alkaloids, a committee, consisting of Messrs. H. C. Wood, Thos. Meehan, John K. Valentine, Isaac C. Martindale and John H. Redfield, was appointed to memorialize Congress as to the importance of making suitable experiment in the cultivation of Cuprea bark within the limits of the United States.

No reports from these committees have as yet been received.

All of which is respectfully submitted,

EDW. J. NOLAN,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

In accordance with the laws of the Academy, the Corresponding Secretary submits the following report for the year ending Nov. 30, 1882.

The business for the year has consisted, for the most part, of letters from corresponding societies transmitting their publications and acknowledging the receipt of those sent by us, as well as acknowledgments from newly elected Correspondents.

The correspondence from the Academy has been the official acknowledgments and thanks of the society for donations of various kinds to the Museum, and the notification of Correspondents of their election.

In addition there is always an amount of miscellaneous correspondence, the greater part of which has been brought before the Academy for its action when needed; otherwise the letters, usually of inquiry, have been promptly answered.

During the summer the Corresponding Secretary had the opportunity of visiting the libraries of many corresponding societies, and found the exchanges in good state of completeness and as promptly received as is usual through the international exchange. Deficiencies were, however, detected in some instances and requests have since been officially received for missing parts.

During my absence the duties of the position were kindly and ably performed by Prof. Angelo Heilprin.

The summary is as follows:—

LETTERS RECEIVED.	
Acknowledgments from Corresponding Societies,	46
Letters of transmission of publications,	50
Acknowledgments of election,	7
Miscellaneous,	17
LETTERS SENT.	
Acknowledgments of donations to Museum,	165
Notifications of Correspondents elected,	6
Miscellaneous,	12

The donations to the Museum have been acknowledged in full to the donors, the number above indicating merely the letters sent; a more detailed account will appear in the Curators' report.

Respectfully submitted,

GEORGE H. HORN, M. D.,
Corresponding Secretary.

REPORT OF THE LIBRARIAN.

The Librarian reports that during the year ending Nov. 30, 1882, there have been 2795 additions made to the library of the Academy. This increase has been composed of 366 volumes, 2417 pamphlets and parts of periodicals, and 12 maps. The larger number consists as heretofore of instalments of journals and transactions received in exchange for the publications of the Academy from corresponding societies.

The sources from which this increase has been derived is as follows:—

Societies, ...	1058	Trustees of Public Library, Victoria, ...	2
Editors, ...	769	Health Department, N. York,	2
I. V. Williamson Fund, . .	291	Rev. Dr. Syle, ...	1
Authors, ...	230	Liverpool Free Public Library,	1
F. V. Hayden, ...	158	Geodetic Commission of the Netherlands, ...	1
Jos. Jeanes, ...	61	Fish Commissioners of Connecticut, ...	1
Wilson Fund, ...	50	J. A. Ryder, ...	1
Geo. Vaux, ...	41	Geol. Survey of Minnesota, .	1
Department of the Interior, .	21	B. Westermann & Co., . .	1
Department of Agriculture, .	13	Department of Mines, Nova Scotia.	1
Geological Surv. of Belgium,	13	Department of Mines, N. S. W.	1
Executors of the late Dr. Robert Bridges, ...	12	Asa Gray, ...	1
Geological Survey of India, .	10	U. S. Coast Survey, . . .	1
Engineer Department, U.S.A.	8	Louisiana Board of Health,	1
Isaac Lea, ...	8	Rev. H. C. McCook, . . .	1
Minister of Public Works, France, ...	6	Geological Survey of Pennsylvania, ...	1
Treasury Department, . .	5	Thomas Meehan, ...	1
War Department, ...	4	Trustees of City Hospital, Boston, ...	1
British Museum, ...	3	G. W. Fox, ...	1
Smithsonian Institution, .	3	Mayor of Brighton, . . .	1
Minister of Public Works, Mexico, ...	3	Australian Museum, Sydney,	1
Geological Survey of New Jersey, ...	2	Royal College of Surgeons,	1
Geological Survey of Canada,	2		
Norwegian Government, .	2		

The books and pamphlets obtained from these sources were distributed to the various departments of the library as follows:—

Journals, ...	2124	Botany, ...	55
Geology, ...	185	Bibliography, ...	19
General Natural History, . .	69	Chemistry, ...	18
Conchology, ...	62	Anthropology, ...	17
Mineralogy, ...	60	Ornithology, ...	14
Entomology, ...	58	Agriculture, ...	13

Physical Science,	12	Herpetology,	6
Voyages and Travels,	10	Encyclopedias,	5
Helminthology,	9	Education,	4
Ichthyology,	9	Geography,	3
Medicine,	8	Languages,	1
Mammalogy,	8	Miscellaneous,	18
Anatomy and Physiology,	8		

The income of the I.V. Williamson Fund has been mainly devoted during the past year to the purchase of continuations of books already subscribed for, and to the paying of bills which had accumulated in consequence of the failure of some of the ground-rents from which the fund is derived, as noticed in my last annual report. These bills have now all been paid and the entire income of the fund for the coming year will be at the disposal of the committee. With the exception of Elliott's Felidæ and Bucerotidæ, but little has been obtained from the income of the Wilson Fund, except the continuations of works subscribed for by the late Dr. Thos. B. Wilson.

The more valuable books in addition to those received from the above funds and in exchange, have been the gift of Mr. Jos. Jeanes, who, in addition to the $739.80 recorded in my last report, as having been given by him for the purchase of geological and botanical books, has placed during the past year $300 at the disposal of the Library Committee for the purchase of such miscellaneous works as were immediately desirable. The titles of works thus obtained, as well as those of all others received during the year, will be found in the appended list of additions to the library.

The Academy is also indebted to Mr. Jeanes for a gift of $300 to be used in binding journals, etc., subscribed for from the I. V. Williamson Fund.

At a meeting of the Academy held April 26, 1882, it was resolved, in accordance with the recommendation of the Council, to authorize the Library Committee to accept the proposition which had been received from Mr. Geo. W. Tryon, Jr., under date of Jan. 16, to dispose by sale of certain works in the library, which were in no sense connected with natural history, together with the duplicates which had been accumulating for years. The proposition to select, catalogue and sell these books under the supervision of the Library Committee was made on condition that one-half the net proceeds, after paying expenses, should be transferred to the Academy, and the other half to the Conchological

Section to form the nucleus of a fund for the purchase of specimens for the Museum.

The sale was authorized under the conviction that many valuable books on the Fine Arts and general literature would be of more use in collections where they would be inquired for and consulted than if they were retained as part of the library of the Academy, from the specialty of which they were so distinct. Such a disposition of these books and the accumulated duplicates as would be of greatest benefit to the library of the Academy would certainly meet with the approval of their liberal donors, chief among whom were Wm. Maclure and Dr. Thomas B. Wilson.

About 1897 volumes were thus disposed of; 1272 were works on religion, history, politics and general literature, for the most part of little interest or value; 424 were duplicates and 201 were on the fine arts, architecture, antiquities, etc. Care was taken to retain everything which could be considered as even remotely pertaining to natural history.

The proceeds of the sale amounted to $1325.14, the Academy's share of which, $662.57, was appropriated for binding. Each volume thus bound has a label placed on the inside of the cover properly crediting the fund. This amount, in addition to the sum received from Mr. Jeanes, has enabled me to have bound during the year 677 volumes, while 240 are in process of binding. It is believed that a sufficient balance will remain to provide for the binding of about 200 volumes in addition to those above noted. The binding of our periodicals had been some years in arrears, and the work now done, although it forwards the orderly arrangement of the library and adds greatly to the convenience of readers, leaves a large number of volumes still in unbound parts.

Every effort has been made as heretofore to keep our large collection of periodicals as complete as possible by purchase and exchange. Nearly all the applications made for deficiencies during the year have been answered promptly and satisfactorily.

A portrait in oil of the late Prof. S. S. Haldeman, painted by Waugh, was presented by Mrs. S. J. Haldeman Haly, and one of Dr. Thos. B. Wilson, by Uhlke, of Washington, has been obtained by subscription. The latter portrait completes the gallery of past Presidents with the exception of Dr. Robert Bridges. An effort is being made, with almost the certainty of success, to secure by

subscription a portrait of Dr. Bridges, which, it is hoped, will be hung in place early in the year. A framed life-sized crayon portrait of Prof. John Tyndall was presented by the artist, Mr. Ross.

In view of the above statements the Academy may be congratulated on the fact that the past year has been an unusually prosperous one for the library.

All of which is respectfully submitted,

EDW. J. NOLAN,
Librarian.

REPORT OF THE CURATORS.

The Curators present the following from the Curator-in-charge as their report for the year ending November 30, 1882:—

I would respectfully report, that during the year Mr. C. H. Townsend has been engaged in separating the families of Passerine birds, from the general ornithological collection, preparatory to a better arrangement of that order.

Mr. G. Howard Parker has been engaged in the arrangement of the Coleoptera.

The various collections have been carefully examined, and are in good condition.

The specimens presented to the Museum during the year have been labeled, and placed in their proper places.

Some progress has been made in labeling and arranging of specimens in the Museum.

Respectfully,

C. F. PARKER.

SUMMARY OF THE REPORT OF WM. C. HENSZEY,

TREASURER, FOR THE YEAR ENDING NOV. 30, 1882.

DR.

To Balance from last account		$ 918 71	
" Initiation fees		140 00	
" Contributions (semi-annual contributions)		1927 51	
" Life Memberships		200 00	
" Admissions to Museum		458 60	
" Sale of Guide to Museum		45 00	
" Sale of duplicate books	$ 5 00	667 57	
" One-half proceeds of sale of books	662 57		
" Sale of paper		1 05	
" Freight returned		13 75	
" Fees, Lectures on Palæontology		168 00	
" " " " Mineralogy		28 00	
" Publication Committee		1362 57	
" Interest from Mortgage Investments, Joshua T. Jeanes' Legacy		1000 00	
" Wilson Fund toward Salary of Librarian		300 00	
" By Publication Fund. Interest on Investments		508 55	
" Barton Fund. " " "		480 00	
" Life Membership Fund. " " "		100 00	
" Maintenance Fund. " " "		50 00	
" Eckfeldt Fund. " " "		69 79	
" Interest on Deposits		51 10	
			$8490 20

CR.

Salaries, Janitors, etc		$3204 96	
Freight		38 21	
Repairs		352 93	
Insurance		30 00	
Coal		418 00	
Gas		134 85	
Mounting Bird		1 50	
Printing, Stationery and Postage Stamps		126 77	
Alcohol		2 80	
Newspaper reports		92 00	
Water Rent		26 15	
Trays		49 00	
Printing and Paper	$1275 28	1305 28	
Binding same	30 00		
Plates and Engravings		197 00	
Binding		429 75	
Six Cases of Drawers		136 50	
Guides to Museum		23 00	
Books		44 15	
Trubner & Co., London		59 96	
A. Heilprin, fees from Lectures on Palæontology		168 00	
H. C. Lewis, fees from Lectures on Mineralogy		28 00	
Life Memberships, transferred to Life Membership Fund,		200 00	
Transferred to Stott Legacy Fund		2 00	
Miscellaneous		428 58	
			$7498 89

Balance, General Account	$991 31

LIFE MEMBERSHIP FUND. (For Maintenance.)

Balance per last Statement	$1100 00
Life Memberships transferred to this account	200 00
Interest on Investments	100 00
	$1400 00
Transferred to General Account	100 00
To Balance for Investment	$1300 00

BARTON FUND. (For Printing and Illustrating Publications.)

Balance per last Statement	$240 00
Interest on Investments	240 00
	$480 00
Transferred to General Account	480 00

JESSUP FUND. (For Support of Students.)

Balance per last Statement	$581 67
Interest on Investments	560 00
	$1141 67
Disbursed	430 00
Balance	$711 67

PUBLICATION FUND.

Balance per last Statement	$1408 25
Income from Investments	290 00
I. C. Martindale. Life Subscription to Proceedings	25 00
	$1723 25
Transferred to General Account	508 55
To Balance for Investment	$1214 70

MAINTENANCE FUND.

Balance per last Statement		$ 626 35
Interest on Investments		50 00
Isaac C. Martindale		6 79
Joseph Wharton		1000 00
Susan W. Logan and A. Sydney Logan, Executors J. Dickinson Logan, deceased	$500 00	
Less Collateral Inheritance Tax	25 00	
		475 00
		$2158 14
Transferred to General Account		50 00
To Balance for Investment		$2108 14

Mrs. STOTT FUND. (For Publications.)

Balance per last Statement for Investment		$2000 00
Transferred from General Account		2 00
		$2002 00
By Balance	$ 2 00	
Investment in Bond and Mortgage, 5 per cent. Interest	700 00	
		702 00
To Balance for Investment		$1300 00

ECKFELDT FUND.

Balance per last Statement for Investment	$966 86
Interest on Investments	69 79
	$1036 65
Transferred to General Account	69 79
To Balance for Investment	$966 86

I. V. WILLIAMSON LIBRARY FUND.

Balance per last Statement		$41 46
Rents collected		771 50
Ground-rents collected		1197 99
		$2010 95
For Books	$1040 31	
Subscription to Journal	3 00	
Binding	4 45	
Taxes and Repairs to Properties	429 17	
Collecting	100 54	
		1577 47
Balance		$433 48

THOMAS B. WILSON LIBRARY FUND.

Balance overdrawn as per last Statement	$113 38
For Books	340 61
For Binding	3 90
Transferred to General Account toward Salary of Librarian	300 00
	$757 89
Interest on Investments	525 00
Balance Overdrawn	$232 89

MUSEUM FUND.

Donation from Unknown Friend, per Joseph Jeanes, Esq., for Investment	$1000 00

BOOK FUND.

Balance per last Statement	$525 80
Joseph Jeanes. Donation	300 00
Thomas Meehan. For Books	12 69
	$838 49
Less cash paid for Books	498 66
Balance	$339 83

INSTRUCTION FUND.

Balance per last Statement	$35 00
Isaac C. Martindale	1 30
Frederick Gutekunst	10 00
John T. Morris	50 00
	$96 30
Less cash disbursed for purposes appertaining to the Fund	36 30
Balance	$60 00

BINDING FUND. (Donations from Joseph Jeanes, Esq.)

Joseph Jeanes. Donations	$300 00
Less cash disbursed for Binding	22 15
Balance	$277 85

REPORT OF BIOLOGICAL AND MICROSCOPICAL SECTION.

Eighteen meetings were held during the year, with an average attendance of about fifteen members.

The following were elected members:—Dr. Crozier Griffith, Dr. George A. Rex, Edward P. Starr, Wilson Mitchell.

The following became contributors:—Dr. McClurg, J. H. Fenton, Dr. R. A. Rainear, J. F. Herbert, D. S. Newhall.

The following resigned membership:—J. E. Mitchell, Dr. R. J. Levis, Dr. Guilford, Dr. Charles Turnbull.

The following members have died:—Dr. George Dixon, Dr. Robert S. Kenderdine, William S. Vaux.

During the year many valuable communications were brought before the Section, and interesting discussions kept up the usual attendance of members and visitors. Among the more valuable communications, etc., may be mentioned those by the following gentlemen:—

Mr. D. S. Holman.—An exhibition of a Projecting Microscope of peculiar design.

Dr. L. Brewer Hall.—An Eye Protector, to be used upon the draw tube of the microscope.

Mr. Balen.—An exhibition of living objects, especially specimens of *Philodina*, *Pandorina*, etc.

Mr. Mitchell McAllister.—A lecture upon the Cultivation of Hyacinths.

Mr. John Ryder.—Upon the Embryology of Fishes. Also upon a Compressorium of special design for study of the above.

Mr. George Binder.—Extended observations upon the *Antherenis.*

Mr. J. Schimmel.—Extended observations upon the *Chilodon cucullulus.*

Dr. G. A. Rex.—Lecture upon the Classification of the Myxomycetes.

Mr. Edward Potts.—Lecture upon Fresh-water Sponges, and their Classification.

Mr. Jacob Binder.—Extended observations upon the Sucking Cups upon the fresh-water beetles.

Dr. J. G. Hunt.—Upon Reproduction in the Algæ. Also upon Special Methods of Preparation and Mounting of Microscopical Objects.

Dr. Crozier Griffith.—Upon the Minute Anatomy of the Kidney, and upon the Vasa Recta Vessels of the Testicle.

Mr. Charles Perot.—Upon the Development of *Attacus.*

Dr. Alfred Reed.—Upon Vaccine Virus.

Mr. John C. Wilson.—Upon *Collomia coccinea.*

On October 16, the Mineralogical Section of the Academy, by invitation, met with this Section in the consideration of objects of interest to both.

At the Annual Meeting held the first Monday in December, the following were elected officers to serve during the year:—

Director, ... Mr. Jacob Binder.
Vice-Director, ... Mr. John C. Wilson.
Recorder, ... Dr. Robert J. Hess.
Corresponding Secretary, . . Dr. L. Ashley Faught.
Treasurer, ... Dr. Isaac Norris, Jr.
Conservator, ... Mr. Charles P. Perot.

Respectfully,

ROBERT J. HESS,

Recorder.

REPORT OF THE CONCHOLOGICAL SECTION.

The Recorder of the Conchological Section respectfully reports that papers by Prof. Angelo Heilprin, Rafael Arango, T. W. Eastlake and R. E. C. Stearns have been published in the Academy's Proceedings.

Since last report, two members, Wm. S. Vaux and Chas. M. Wheatley, and one correspondent, Dr. F. H. Troschel, have died.

Mr. Vaux became a member December 6, 1867, and was a frequent and liberal contributor to our Museum.

Mr. Wheatley was elected January 3, 1867. He for many years studied the Fresh-water Mollusks, and contributed freely both to our Museum and publications.

Dr. Troschel was elected a correspondent August 1, 1867. His death leaves incomplete his great work upon the Dentition of the Mollusca. Besides being the author of numerous other papers, principally upon the Anatomy of Mollusks, Dr. Troschel had for years annually reviewed the literature of Conchology for Wiegmann's "Archiv für Naturgeschichte." His death is a loss to science, especially in his own department.

Mr. Geo. W. Tryon, Jr., Conservator, reports that:—

"During the year ending December 1, 1882, fifty-two donations of recent shells and mollusks have been received, aggregating 2049 specimens of 724 species. Assisted as usual by Mr. Chas. F. Parker, these additions have all been labeled, mounted and arranged in the general collection, which now numbers 40,225 named tablets, upon which are mounted 141,641 specimens. A detailed list of the accessions for the year is annexed to this report. The most important of these are: A collection of 221 species, all new to the Museum, purchased by the Section; 61 species of Californian marine shells, including a number of rare and fine specimens, presented by Joseph Jeanes; 123 species of Tasmanian marine shells, nearly all new to our collection, presented by C. E. Beddome, of Hobart Town, Tasmania. To our generous Australian correspondents, Dr. J. C. Cox and Mr. John Brazier, we are again indebted for valuable suites of their native shells.

"The rearrangement of the Conchological Museum, commenced four years ago, is progressing. During the year, the Marginellidæ and Olividæ have been revised and largely relabeled. Some idea

of the extent and completeness of our collection may be formed from the fact that in these two families alone it includes 946 trays. The Columbellidæ and Cypræadæ are now undergoing like revision, the latter by Mr. S. R. Roberts."

There have been no changes made in the By-Laws of the Section.

The officers of the Section for 1883 are:—

Director, ...	W. S. W. Ruschenberger.
Vice-Director, . . .	John Ford.
Recorder, ...	S. Raymond Roberts.
Secretary, ...	John H. Redfield.
Librarian, ...	Edw. J. Nolan.
Conservator, . . .	Geo. W. Tryon, Jr.
Treasurer, ...	Wm. L. Mactier.

Respectfully submitted, on behalf of the Conchological Section, by

S. Raymond Roberts,
Recorder.

REPORT OF THE BOTANICAL SECTION.

The Vice-Director of the Botanical Section takes great pride in reporting, that notwithstanding the agreeable reports he has had to make in former years, he believes the prosperity of the work of the Section has been greater during this than any former one. Meetings have been held in all but the two summer months, and many valuable facts communicated, some of which have been repeated before the general meetings of the Academy, and published in its Proceedings. There are no debts of any consequence against the Section, while its Treasurer reports a balance on hand of $119.92. During the year one member has resigned, and it has lost one by death. The officers elected for the ensuing year are as follows:—

Director, ...	Dr. W. S. W. Ruschenberger.
Vice-Director, . .	Thomas Meehan.
Recorder, . . .	F. Lamson Scribner.
Cor. Secretary, *Treasurer*, . .	Isaac C. Martindale.
Conservator, . . .	J. H. Redfield.

It seems almost superfluous to repeat what has been so often said before in these reports, that the voluntary work of the mem-

bers is not equal to the task of placing the magnificent Herbarium of the Academy on the footing it is worthy of occupying, unless some competent botanist could be employed within a reasonable time. Still in the hope that the Academy may soon see its way to aid them, the members continue to do what they can; and the Section has very great pleasure in adopting the report of its Conservator, as part of its report of the work of the year.

Respectfully submitted,

THOMAS MEEHAN,
Vice-Director.

Conservator's Report.—The additions to the Herbarium of the Academy during the past year, exceed those of any year since the organization of the Section, being estimated at 3346 species, of which more than one-third were new to the collection, and adding more than 100 genera not before represented.

For a large proportion of these we are indebted to the zeal and liberality of our own members, who have evinced a laudable desire to perfect the Academy's collection, by filling its desiderata, and by improving the character of the representation of species already possessed. Special thanks are due to Messrs. Canby, Parker, Martindale, Meehan and others, for their efforts in this direction.

But we have also been favored with most liberal donations from other sources. From Dr. Gray, of the Cambridge Herbarium, we have received more than 1000 species. Among them we may specify a second collection of plants made in the Kuram Valley, Afghanistan, in 1880, by Major J. E. T. Aitcheson, and valuable accessions from China, Formosa, Japan, Australia and Tasmania; also a fine series of the polypetalous plants of our Mexican border, collected by Schaffner, Havard, Palmer and others, which, supplementing a collection of Palmer's plants from one of our own members, give us a very full representation of the plants of the Texo-Mexican region.

Baron F. von Müller, of Melbourne, Australia, has sent us, through Mr. Meehan, 284 species of Australian plants, many of them desiderata, and from Prof. Sargent, of the U. S. Forestry Commission, we have received choice herbarium specimens of some of the rarer trees and shrubs of our western regions. A more complete list of the donations for the year will be appended.

The care and labor incident to the reception of these additions have been great, and though the Conservator has received most essential assistance from Messrs. Parker, Burk, Meehan and Scribner, he has had little time left to devote to the improvement of the condition of the herbarium. Yet something has been done in this way. Provisional lists of species in the general herbarium have been completed nearly to the end of the polypetalous orders. In the North American Herbarium, the orders Ranunculaceæ, Saxifragaceæ, and a few smaller orders have been mounted by the aid of Mr. Parker, who has also contributed liberally to the filling of gaps in these orders, for this purpose placing his own collection entirely at the disposal of the Conservator.

Respectfully submitted,

JOHN H. REDFIELD,

Conservator.

REPORT OF MINERALOGICAL AND GEOLOGICAL SECTION.

The Director of the Mineralogical and Geological Section would respectfully report:—

Meetings of the Section have been held regularly through the year, with a fair attendance, but the papers read have not been as numerous as in former years. The additions to the Collection have been satisfactory.

On the evening of October 15th, by request of the members of the Microscopical and Biological Section, our Section met with them, the subject under consideration being Microscopic Mineralogy. By the courtesy of the former Section a large number of microscopes, many of them very fine instruments, were exhibited, and by means of them specimens of minerals and rocks were examined. This was the first joint meeting of Sections since the passage of the amendment to the By-laws removing the prohibition against it, and its success was beyond question.

Respectfully submitted,

THEO. D. RAND,

Director.

REPORT OF THE PROFESSOR OF INVERTEBRATE PALÆONTOLOGY.

The Professor of Invertebrate Palæontology respectfully reports that during the year 1882 a course of 36 lectures on Physiography and Invertebrate Palæontology was delivered in the class-room of the Academy (commencing Jan. 6, and terminating May 9), which course was attended by an average of about 27 listeners, largely made up of teachers, male and female, from some of the more prominent institutions of learning in the city.

The additions to the Palæontological Department of the Academy's Museum, which will be found recorded in another place, have been during the present year comparatively insignificant; but no special attempts have been made to increase the collections in this direction, since it was deemed advisable not to further burden the department until more of the old stock had been worked off through arrangement and classification. The most important contribution received (although not yet formally presented to the Academy) is that of true Nummulites from the Peninsula of Florida, the first and only representatives of that highly important group of organisms thus far discovered on the continent of North America.

The work of labeling and classifying the old collections in the Palæontological Department of the Academy has made considerable progress during the year, the determination of specimens embracing material contained in about 300 trays. The Conservator is pleased to state that almost the entire series of Tertiary fossils of the eastern United States—Eocene, Oligocene, Miocene, and so-called Pliocene—is now satisfactorily displayed and labeled, the re-determination and identification of species having been effected for upwards of 1700 trays. The collection, as it now stands, constitutes by far the most important and typical collection of tertiary invertebrate fossils in the country, and must form for some time to come the groundwork for any standard work bearing upon this section of American palæontological history.

The department of the library pertaining to Geology and Palæontology has received many valuable accessions during the year, for a considerable portion of which the Academy is again indebted to the liberality of Mr. Joseph Jeanes.

The department is also largely indebted to Mr. Chas. F. Parker, Curator-in-charge, who has kindly undertaken the mounting of specimens.

Respectfully,

ANGELO HEILPRIN,

Professor of Invertebrate Palæontology.

REPORT OF THE PROFESSOR OF MINERALOGY.

The Professor of Mineralogy respectfully reports that in addition to the usual work of classifying the collections under his charge, he has delivered during the winter and spring of 1882, a course of 28 lectures on Mineralogy.

The lectures, given under the auspices of the Committee on Instruction, began on January 5, 1882, and were given tri-weekly in the class-room of the Academy. They included an examination of the valuable collection of the Academy, and practical demonstrations of the method of determining minerals both by their external and by their chemical characters.

The mineralogical collection is gradually increasing in size and in value. In the absence of any specific fund for the purchase of new specimens, it has not been possible to add to its number of species except by exchange or through donations. Special care has been taken that where minerals are acquired by exchange or otherwise, preference should be given to species not in the collection. 300 specimens have been received through donation or exchange, 37 of which are species new to the collection. A detailed catalogue of these, with the donors, is given in the appended list, the minerals new to the collection being printed in italics. The most noteworthy addition to the collection has been the donation of Mr. J. M. Hartman of a large number of specimens. The lithological collection has also been increased by some 43 specimens. The labeling and mounting of the specimens has been performed as before by Mr. Chas. F. Parker, Curator-in-charge, whose skill in such work has greatly increased the beauty of the collection.

The attention of the friends of the Academy is again drawn to the necessity of mineralogical apparatus for the prosecution of advanced mineralogical work. The Professor of Mineralogy has been unable to properly classify the large collection of feldspars

in the Academy, for want of a suitable polarizing microscope. The work will be undertaken as soon as an instrument is obtained. The micas have been classified by the aid of an instrument made at his own expense. A reflecting goniometer is also greatly to be desired, both for class instruction and for the proper determination of many crystalline forms in the collection.

By the death of Mr. Wm. S. Vaux the Academy has lost a most liberal contributor to the mineralogical collection. Arrangements are now in progress, which it is hoped will result in transferring his very valuable collection to the custody of the Academy.

Respectfully submitted,

H. CARVILL LEWIS,
Professor of Mineralogy.

The election of Officers for 1883 was held, with the following result:—

President, . . .	Joseph Leidy, M. D.
Vice-Presidents, . .	Thomas Meehan,
	Rev. Henry C. McCook, D. D.
Recording Secretary, .	Edward J. Nolan, M. D.
Corresponding Secretary,	George H. Horn, M. D.
Treasurer, . . .	William C. Henszey.
Librarian, . . .	Edward J. Nolan, M. D.
Curators, . . .	Joseph Leidy, M. D.,
	Chas. F. Parker,
	Jacob Binder,
	W. S. W. Ruschenberger, M. D.
Councillors to serve three	Thomas A. Robinson,
years, . . .	Edward Potts,
	Isaac C. Martindale,
	Theodore D. Rand.
Finance Committee, .	Isaac C. Martindale,
	Clarence S. Bement,
	Aubrey H. Smith,
	S. Fisher Corlies,
	George Y. Shoemaker.

ELECTIONS DURING 1882.

MEMBERS.

January 31.—Robert B. Haines, Jr., Alfred C. Harrison, Abel F. Price, M. D., Rev. W. J. Holland, Chas. H. Hutchinson, Wilson Mitchell.

February 28.—Frank E. P. Lynde.

March 28.—John Edgar, M. D., Eugene M. Aaron, Geo. Taylor Robinson, M. D.

April 25.—Thomas Moore, M. D.

June 27.—Henry Howson.

September 26.—William M. Gray, M. D.

November 28.—F. Lynwood Garrison, Mrs. H. Carvill Lewis.

CORRESPONDENTS.

January 31.—Dr. A. Baltzer, of Zurich; Prof. Robert Collett, of Christiania.

February 28.—Prof. Robert Hartmann, of Berlin; Prof. W. Kowalevsky, of Moscow; Dr. K. Martin, of Leyden.

July 25.—Dr. Maxwell T. Masters, of London.

ADDITIONS TO THE MUSEUM.

December 1, 1881, to December 1, 1882.

Mammals.—Dr. Thomas Biddle. Mounted specimen of *Ornithorhynchus anatinus*, Australia

Dr. H. C. Eckstein, U. S. N. Skull and tusks of *Odobænus rosmarus*, Spitzbergen.

Jos. Jeanes. Mounted skeleton of domestic hog.

Dr. Joseph Leidy. *Hesperomys leucopus*, N. J.

P. Reuter. Fœtus of horse.

A. S. Sweeten. Fungus parasite on young rat.

G. & A. Ulrich. Mouse (monstrosity).

James F. Wood, through E. M. Aaron. Female human skeleton, Cooper's Pt., N. J.

W. S. Vaux. Two Indian skulls, Hamilton Co., Ohio.

Birds.—Phila. Zool. Society. *Polyborus tharus*, S. A. *Porphyria melanotus*, Australia. *Penelope pileata*. Brazil.

Dr. H. C. Eckstein. Skins of *Larus tridactylus*, *Fulmurus glacialis* and *Somateria v. nigra* with nest and three eggs, Spitzbergen.

B. H. King. *Tyrannus carolinensis*, Calhoun, Ga

Ophidians, Reptiles and *Fishes.*—Phila. Zool. Society. *Python moluris* (2 specimens), India.

A. A. Alexander. *Heloderma horridum*, Arizona.

Dr. Geo. W. Lawrence. Double-headed snake, Hot Springs, Ark.

T. R. Peale. *Pseudemys rugosa*. Rehoboth, Del.

C. H. Townsend. *Menopoma alleghaniense*, Pa.

Mrs. M. A. Haldeman. Beak of *Pristis*, Essequebo River, Demerara.

Dr. W. N. Whitney. *Hippocampus*, *Ostracion* and lower jaw of *Cestracion*, Japan.

Articulates.—W. Y. Heberton. *Limulus polyphemus*, Cape May Point, N. J.

Jos. Jeanes. Sixteen species crustaceans, San Diego, Cal.

Mrs. M. T Keemblé. Two cases of insects, Brazil.

Dr. Joseph Leidy. *Balanus balanoides*, Bass Rocks, Gloucester, Mass.

Dr. Joseph Wilson. Galls on cultivated grapevine.

W. N. Lockington. *Astacus nigrescens*, Cal.

Maria J. Moss. *Mantis carolina*, Washington, D. C.

Mollusks.—Arango, R. Thirteen species of land shells from Cuba.

Barber, E. A. Fourteen species of land and fresh-water shells from Colorado. *Helix strigosa*. *H. fulva*, *H. suppressa*, *H. pulchella*, *H. striatella*, *Sphærium solidulum*, *Pisidium virginicum*, *Physa heterostropha*, *Planorbis parvis*, *Limnæa caperata*, *Pupa Blandi*, *P. Rowelli*, *Vitrina Pfeifferi* and *Ancylus*.

Beddome, C. E. 123 species of Tasmanian marine shells, mostly new to the Academy's Collection, and recently described by Rev. J. E. Tenison-Woods.

Bland, Thomas. Nine species of land shells from various localities.

Brazier, John. *Voluta marmorata*, *V. punctata*. *V. Ellioti*. *V. Norrisi*, *Bulimus Rossiteri* (types), *Cypræa Bregeriana*, *C. quadrimaculata*, *C. stolida*, *C. Walkeri*, *Murex Angasi*; twenty-five species, mostly marine shells, from various localities; forty-eight species and varieties of marine shells from Australia.

Brown, J, J. Four species of marine shells from Honduras.

Bush, Mrs. A. E. *Pecten monotimeris* Con., Cal. 17 species of land, fresh-water and marine shells, from various localities.

Bush, Mrs. A. E. Nine species of land and fresh-water shells from California.

Clark, T. W. B. *Martesia cuneiformis*, Chesapeake Bay, Md.

Conchological Section. 221 species of shells, all new to the collection, purchased; Glass models of *Eledone moschatus*, *Doris debilis*, *Doriopsis clavulata*, and *Flabellina janthina*.

Coulter, Prof. J. M. Two specimens of *Hippopus maculatus*.

Cox, Dr. J. C. Thirty-four species of marine shells from Australia; *Neæra latisulcata*, N. S. Wales.

Forbes, J. A. *Planorbis exacutus*, Illinois.

Ford, John. *Natica heros* and *N. duplicata*, Newport, R I.; *Clea cochlea*, Sandwich Islands; *Cypræa helvola*, Singapore; *Casidula rugata*, Australia; *Cypræa lurida* (abnormal); *Bulimus Binneyanus* Pfr., Peru.

Hartman, Dr. W. D. *Auricula* (sp.), Japan; *Vitrina Thomsoni* and *Neritina pulligera*, Australia; *Physa osculans*, *Helix strigosa*, from N. Mexico · *Bulimus loyaltyensis*, Loyalty Isl.

Hutton, Prof. F. W. Sixteen species (types) of marine shells from N. Zealand.

James, Jos. F. *Limax maximus*, Cincinnati, O.

Jeanes, Jos. Twenty-eight species of marine shells from California; thirty-three species of marine shells, San Diego, Cal.

Keehmlé, Mrs. M. T. Three eggs of *Bulimus ovatus*, from Brazil.

Latchford, F. R. *Vertigo ovata* Say; *Amnicola decisa* Hald., Quebec, Can.; *Unio ventricosus*, Ottawa River, Ontario.

Lawrence, Dr. Geo. W. *Goniobasis symmetrica* Hald., N. Carolina.

Leidy, Dr. Jos. Five specimens of *Solen ensis* (with animal), Atlantic City, N. J.; *Purpura lapillus*, *Littorina littorea*, Bass Rock, Gloucester Co., Mass.

Orcutt, C. R. *Pupa hordeacea*, San Diego, Cal.; six species of shells, San Diego, Cal.; *Murex trialatus*, *Acmæa patina*, *Chiton pseudodenticus*, *Physa distinguenda*, *Lymnæa Adelinæ*, *Succinea oregonensis*; five species of shells San Diego, Cal.

Potts, Edw. *Sphærium securis*, Prime, N. J.

Ryder, J. A. Egg-cases of *Buccinum undatum*, *Limax maximus* (dissection), *Ostræa virginica* (yearling). *Ostræa edulis*.

Spinner, Hon. F. E. *Arca floridana* and *A. americana*, Florida; *Fusus carica* and var. *eliceans*, *Arca floridana*, Florida.

Streng, L. H. Nine species of fresh-water shells; *Anodonta imbricata*, *A. imbecilis*, *A. modesta*, *A. ovata*, *A. subgibbosa*, *A. Houghtonensis*, *A. Benedicti*, *Unio ventricosus* and *Succinea Higginsi*, from Michigan.

Tryon, Geo. W., Jr. Ten glass models of Mollusca; *Tremoctopus violaceus*, *Verania sicula*, *Helix pomatia* (dissected), *Clionopsis Krohnii*, *Tiedemannia neapolitana* (development), *Lophocercus viridis*, *Parmarion papillaris*, *Daudebardia rufa*, *Parmacella valenciennesi* and *Vaginulus Moreleti*; *Goniobasis virginica*, Mt. Vernon, Va.

Wetherby, Prof. A. G. Eleven species of land and fresh-water shells, N. Carolina; also *Helix alternata* (ribbed variety), *H. Sayi* (var. *chilhoweensis*), Tennessee; *Planorbis glabratus* and *Physa gyrina*, Florida; seven species of land and fresh-water shells from Miami Co., Florida.

Whitney, Dr. W. N. Six species of marine shells from Japan; ten species of marine shells from Yenoshima, Japan.

Willcox, Jos. *Cyrena carolinensis*, *Succinea ovalis* and *Helix septemvolva*, Fla.; *Unio luteolus*, Oneida Lake, N. Y.; *Unio complanatus* Sol., Ontario; *U. complanatus* Sol., Oneida Lake, N. Y., and *U. rectus* Lam., Oneida Lake, N. Y.

Echinodermata.—Jos. Jeanes. *Strongilocentrotus purpuratus*, *S. franciscanus*, *Toxopneustes semituberculatus*, *Echinarachnius excentricus*, *Centrostephanus coronatus*, *Diadema* (sp.). *Ophiura panamensis*, *Ophiothrix spiculata*, *Ophiplocus esmarki*, San Diego, Cal.

W. N. Lockington. *Echinarachnius excentricus*, *Asterias æqualis*, *Ophiura panamensis* and *Astropecten* (sp.), Cal.

Dr. W. N. Whitney. Three species of Echinoderms, Japan.

Cœlenterata, etc.—Jos. Jeanes. *Astropecten stellatus*, *Asterias capitata*, *Asterias* (sp.), *Patiria* (*Asterias*) *miniata*, *Scytaster* (sp.), *Stylatula elongata*, San Diego, Cal.

Miss Drysdale. *Actinia rapiformis*, Atlantic City, N. J

Edw. Potts. *Alcyonidium ramosum* on Stones' Inlet. Atlantic City, N. J., and *Plumatella vesicularis*.

Rev. E. W. Lyle. *Hyalonema mirabilis*, Japan.

Joseph Willcox. Sponge. Florida.

Vertebrate Fossils.—Late Wm. M. Gabb. Seven species of reptiles and fishes, from the cretaceous of Kansas.

E. Florence. Tooth of *Oxyrhina*, Central Australia.

Rev. S. H. Lighthipe. Fragments of jaw of gavial, from the cretaceous marl of Burlington Co., N. J.

W. S. Vaux. Two molars of *Mastodon americanus*, Dick's Creek, Butler Co., Ohio. Three molars of *Elephas primigenius* and lower incisor of *Hippopotamus amphibius*.

Invertebrate Fossils.—Dr. H. C. Eckstein. Carboniferous Limestone, containing *Productus semistriatus* Martin, *P. horridus*, *Aviculopecten* and *Spirifer*, Green Harbor, Spitzbergen.

Joseph Jeanes. *Chione fluctifraga*, *Chione succincta*, *Pecten æquisulcatus*, *Pecten* (*Janira*) *dentata*, *Lucina Nuttalli*, *Lucina*, sp., *Scalaria*, sp.; *Acervularia Davidsoni*, Niagara Group.

Dr. I. Lea. *Panopæa americana*, miocene of Maryland; *Astræa*, miocene of Va.; Corals and bryozoan earth from the greensand, Long Branch, N. J.

Dr. Joseph Wilson. Crinoidal limestone and *Lithostrotion canadense* from the Burlington limestone, Burlington, Iowa.

Archæology.—George C. Henszey. Arrow-head, Pennsgrove, Salem Co., N. J.

Dr. Harry Skinner. Arrow-point, Fairmount Park, Phila.

Plants.—Wm. M. Canby. Section and part of trunk of *Alnus maritima* Muhl.; nine hundred and seventy-one species plants from Europe, Africa, Asia and Australia.

Thos. Meehan. Forty-two species of *Acacia*. Fruit of *Diospyros kaki* and of *Cydonia japonica*. Cones of *Pinus densiflora* and *Pinus Bungeana*, natives of Japan. Thirty-five species of Cactaceæ, from Arizona and southern California; fourteen species of miscellaneous plants from Western N. Am.

Isaac C Martindale. Ellis's North American Fungi, centuries VIII and IX; twenty-nine species of plants from Europe, Australia and N. America.

Baron Ferdinand Müller, of Melbourne, Australia. Two hundred and eighty-four selected species of Australian plants, mostly new to the Herbarium.

John Tatum, of Woodbury, N. J. Section of stem of an old and intertwined *Wistaria Sinensis*.

Hugh D. Vail. Fine specimen of *Echinocactus Wislizeni* Engelm., from vicinity of "Total Wreck" Mine, Arizona.

Dr. A. Gray, of Cambridge, Mass. A second collection (seventy-one species) of plants from Kuram Valley, Afghanistan, made by Major J. E. T. Aitcheson, of British Army, in 1880. Also nine hundred and fifteen species plants from China, Japan, Formosa, Australia, Mexico and Texas.

Charles F. Parker. Forty-three species of N. American Ranunculaceæ; also eleven species of other N. American plants, including three type specimens of Austin's new species.

George E. Davenport, Boston, Mass. Nine species of ferns collected in Unalaska, in 1881, by L. M. Turner.

Charles E. Smith. Specimens of the rare *Corema Conradii* Torr., male and female plants from Shawangunk Mts., Ulster Co., N. Y.

Aubrey H. Smith. Specimens of the same—male and female plants of spring and fall growth, from same locality, and of *Empetrum nigrum*, from Island of Mt. Desert, Maine.

S. B. Buckley, Austin, Texas. *Nymphæa ampla* D. C., from Lampaza Springs, Mexico.

J. G. Lemmon, Oakland, Cal. Cones of *Pinus Arizonica* Engelm., and of *Pinus Chihuahuana* Engelm., from Arizona.

Horace J. Smith, St. Barbara, Cal. *Casuarina quadrivalvis*, an Australian species, cultivated in California.

F. C. Bell, Phila. Photograph of some Hymenocetous Fungus, from one hundred and fifty yards depth in Miller's Colliery, Phœnix Park, Schuylkill Co., Pa.

Charles S. Sargent, Forestry Department of U. S. Census. Fifty-four species shrubs and trees mostly from Western N. America, and Cones of eight species of Conifers from Oregon.

Thomas Bland, N. Y. Specimen of "Dagger Film," prepared from the inner leaves of the Dagger Plant, or *Yucca aloifolia;* used by ladies in Jamaica for making artificial flowers, and for water color painting.

F. L. Scribner. Six species grasses, from Washington Terr. and California.

B. D. M. Langdon, Mobile, Ala. Immature Cones of *Araucaria imbricata* Pavon, native of Chili, cultivated at Mobile.

J. M. Hutchings, Yosemite, California. Specimen of *Sarcodes sanguinea* Torr. in fruit, and of *Pterospora andromedea* Nutt, both from California.

Dr. G. W. Lawrence. Seed vessels of *Oenothera triloba* Nutt, from Hot Springs, Arkansas.

John H. Redfield. Six hundred and seventy-seven species of N. American plants, mostly from Florida, Arizona, Washington Terr., southern California, Texas, and the border provinces of Mexico.

Minerals [1]—Dr. W. D. Hartman. Aragonite, Birmingham Serpentine Quarries, Chester Co., Pa.

Dr. H. C. Eckstein. Bituminous Coal. Green Harbor, Spitzbergen.

The late Wm. M. Gabb. Native gold in magnetic sand, St. Domingo.

H. C Lewis. *Phytocollite*, Scranton, Pa.; Helvite, Amelia Co., Va.

Dr. Geo. W. Lawrence. Mountain leather, Salina Co., Ark.

Rev. S. H. Lighthipe. Fuller's earth, from the marl. Pemberton, N. J.

Dr. Jos. Leidy. White Tourmaline in limestone, De Kalb, St. Lawrence Co., N. Y.; Triphylite and Amblygonite, Mt. Mica, Paris, Me.; Rubellite, by decomposition passing into Steatite, Mt Mica, Me.; Cookeite with Steatite, Mt. Mica, Paris, Me.; Tourmaline passing into Lepidolite, Tourmaline in Lepidolite, Rubellite, Decomposed Rubellite, Mt. Mica, Paris, Me.

Theo. D. Rand. *Arksutite*, *Hagemannite*, Ivigtut, Greenland; *Hydrocuprite*, Lebanon, Pa.; Limonite from Serpentine, Ferruginous Quartz from Serpentine, near Newtown Square, Del. Co., Pa.

W. W. Jeffries. Serpentine with Marmolite, Brinton's Quarry, Chester Co., Pa.

W. L. Mactier. Anthracite Nodules, Luzerne Co., Pa.

Dr. Isaac Lea. Allanite and Zircon, Yellow Springs, Chester Co., Pa.

Jos. Willcox. Limonite altered from Serpentine, Middletown, Del. Co., Pa.

E. S. Reinhold. Copiapite, Mahanoy City, Pa.

Mrs. M. A. Haldeman Catlinite, Head of Pipestone Creek, S. W. Minn.

Wm. S. Vaux. Fine specimens of crystals of Calcite, of Analcime, Datholite and Calcite, Bergen Hill, N. J.; Crocoite and Pyromorphite, Wheatley Mine, Phœnixville, Pa.; Prehnite with Datholite and Pyrite, Bergen Hill, N. J.; Rubellite and Lepidolite in quartz, Mt. Mica, Me.; Gypsum, Monte Doneto, Bologna, Italy; Idocrase, Monte Somma, Vesuvius; Crystals of native sulphur, Girgenti, Sicily.

Mrs. S. L. Oberholtzer. Graphite (3 specimens), Chester Springs, Chester Co., Pa.

E P. Oberholtzer. Magnetite (3 specimens). Warwick, Chester Co., Pa.

Vickers Oberholtzer. Hematite, Pikeland Mine, Chester Co., Pa.

Jos. Jeanes. Meteoric iron, Cohahuila, Mexico; Glaucodot, Tunaberg, Sweden; Nephrite (Jade), Torrent de Arnotte, Alibert, Siberia; Large crystal

[1] Minerals new to the collection in *italics*.

of quartz, Mt. St. Gothard, Switzerland; Chiastolite, Lancaster, Mass.; Allanite, Edenville, N. Y.; Pyromorphite, Ems, Nassau, Germany; Scheelite and Fluorite, Fürstenberg, Saxony; *Ærinite*, Arragon, Spain; *Walchowite* Walchow, Moravia; Lignite, Redwitz, Bavaria; Lignite, Germany; Lignite with Retinite, Grimma, Saxony; *Bast Coal*, Wettersau, Rhein-Pfalz; Obsidian (2 specimens), New Zealand and Island of Lipari, Medt.; Wood Opal (2 specimens), Nevada Co., Cal.; Tourmaline, near Lebanon, N. H.; Pyroxene (2 specimens), De Kalb, St. Lawrence Co, N. Y.; Chlorite, pseud. after Garnet, Spurr Mt. Mine, Mich.; Calcite incrustation, Clermont, France; Scapolite, Bob Lake, Canada.

J. M. Hartman. Native gold in quartz, Venezuela; Native gold in quartz, Arizona; Native gold in quartz, N. C.; Native silver in quartz (3 specimens), Mexico; Native capillary silver in quartz. Mexico; Crystallized copper, Lake Superior, Mich.; Ore Knob copper, N. C.; Dendritic copper, N. C.; Diopside, Garnet and Chlorite, Piedment, Ala.; Coccolite, Amity, N. Y.; Seybertite, Amity. N. Y.; Epidote, Tyrol; Emerald, Bogota; Labradorite, Labrador; Rutile, Macon Co., Ga.; Orthoclase (Amazon Stone), El Paso, Col.; Calcite, Guanajusto, Mexico; Calcite, Mineral Point, Wis.; Calcite, Lake Superior, Mich.; Calcite, loc.?; Sulphur, Lake Co., Cal.; Sulphur, Cal.; Graphite, Ceylon; Graphite, Ticonderoga, N. Y.; Graphite, Brookville, Canada; Sphalerite (Cleiophane), 3 specimens, Franklin, N. J.; Galenite, Japan; Galenite, Mine La Motte, Missouri; Cinnabar, Guadaloupe, Cal.; Wulfenite, Germany?; Wulfenite, Nevada; Heliotrope, India; Calcite, Rossie, N. Y.; Calcite and Copper, Lake Sup, Mich.; Amethyst, coated with Pyrite, Lake Sup., Mich.; Calamine (2 specimens), Franklin, N. J.; Halite (2 specimens), Colorado River, Arizona; Byssolite, Chester Co., Pa.; Ripidolite, Chester Co., Pa.; Moss Agate. Colorado; Nine polished Agates, Paraguay; Six crystals of Spinel, Amity, N. Y.; Limonite (2 specimens), Durham, Pa.; Limonite. Fox Hill, Shenandoah, Va.; Limonite shale, near Fogelsville, Pa.; Limonite (Kidney ore), Lake Superior, Mich.; Limonite, (5 specimens), from Negaunee, Mich.; Brown Tourmaline, Gouverneur, N. Y.; Apophyllite crystal, Bergen Hill, N. J.; Quartz, Japan; Quartz, Lancaster Co., Pa.; Smoky Quartz, El Paso, Col.; Quartz and Specular Hematite, Keswick, England; Yellow Quartz, Sardonyx, Chalcedony, Chalcedony artificially colored, Alps: Fluorite, Arizona; Hematite, Saxony; Hematite, England; Specular Hematite, Elba; Specular Hematite and Quartz, Elba; Ditto., Antwerp, N. Y.; Ditto. (Slickensides), Byram Mine, N. J.; Ditto., ditto., Negaunee, Mich.; Hematite Geode, Col.; Geodes of Calcite in Hematite, Rockwood, Tenn.; Hematite, pseud. of Calamite, Shawnee, Ohio; Hematite, Iron Mt., Mo.; Lenticular Hematite, Frankstown, Pa.; Micaceous Hematite, from Dillsburg, Pa., Rossie, N. Y., Negaunee. Mich, and Va.; Millerite in Hematite, Antwerp, N. Y.; Göthite, Pike's Peak, Col.; Actinolite, Sweden; Fahlunite in Talc, Fahlun, Sweden; Analcite and Mesotype, Nova Scotia; Natrolite, Bergen Hill, N. J.; Azurite, Cornwall, Pa.; Talc, Fowler. N. Y.; Allanite, Sweden; Hornblende, Bohemia; Cassiterite, Australia; Galenite from Colorado, Utah, Arizona, and Sweden; Pyrite, Amboy, N. J., Roxbury, Conn.; Chalcopyrite, Rossie, N. Y., and Nevada Co., Cal.; Zincite and Franklinite, Franklin, N. J.; Zincite and Willemite, Franklin, N. J.; Zincite Foliated, Franklin, N. J.; Sapphire, Sparta, N. J.; Corundum, Ala.; Ilmenite, Amity, N. Y.; Magnetite from Durham, Pa., Lake Superior, Colorado and Mexico; Wood Agate, Col.; Augite and Calcite, Amity, N. Y.; Tremolite var. (Hexagonite), St. Lawrence Co., N. Y.; Mountain Leather, Sweden; Pargasite, N. Y.; Rœpperite, Franklin, N. J.; Willemite and Franklinite, Franklin, N. J; Garnets from Sweden, N. J., and Pa.; Tourmaline in Calcite, Sweden; Sphene, Pectolite, N. J.; Sepiolite, Chester Co., Pa.; Williamsite, Chester, Pa.; Kaolinite, Japan; Wavellite, Ark.; Barite from French Broad, N. C., De Kalb Co., Ga., Missouri, and Saxony; Fibrous Gypsum, Col.; Calcite, Sweden; Siderite,

Conn.; Aragonite, Col., and Mo.; Malachite, Japan; Chalcocite, pseud. after Wood, Texas; Manganite, Lake Superior, Mich.; Serpentine (Marmolite), Bergen Hill, N. J.; Tephroite, Willemite and Franklinite, Franklin, N. J.; *Ludwigite*. Moravicza, Bannat, Siederite in Quartz, Greenland; Obsidian (Pele's Hair) (artificial). Durham, Pa.; Orpiment (artificial), Galenite, Mine La Motte, Mo., and from Illinois; Chalcopyrite, Japan; Marcasite, Mine La Motte, Mo.; Cuprite, New Mexico; Menaccanite (Iserine), Bohemia; *Minium* (artificial). Sala, Sweden; Pyrolusite, Franklin, N. J.; Opal, San Diego, Cal.; Sahlite, Sala, Sweden; Pseud. of Chlorite after Garnet, Mich.; Phlogopite, Sterling, N. J., and Amity, N. Y.; Orthoclase (Lennilite) Lenni, Del. Co., Pa.; Tourmaline in Muscovite, Paris, Me.; Chlorastrolite, Lake Superior; Stilbite, Nova Scotia: Serpentine and Chrysolite, Westville, N. J.; Kaolinite, N. J.; Jefferisite, Chester Co., Pa.; Margarite, Chester, Mass.; *Durangite*, Durango, Mexico; Anglesite and Galenite, Arizona; Calcite (Spartaite), Sparta, N. J; Oölite, Utah; Calcareous Tufa, Japan; Dolomite on Quartz, Mexico; Bituminous Calcite, Sweden; Smithsonite, Mineral Point, Wis.; Strontianite, Georgia; Cerussite, Mexico; Hydromagnesite on Serpentine, Hoboken, N. J.; Azurite, Nevada; Willemite (Troöstite), Franklin, N. J.; Gieseckite, Diana, N Y.; Stalactite (Chalcedony), Florissante, Col; Agalmatolite, Serpentine, Rossie, N Y.

In exchange. Dyscrasite, Hartz Mts.; *Clausthalite*, Tilkesode, Hartz; *Alabandite*, Hagyag, Transylvania; *Breithauptite*, Andreasberg, Hartz; *Arite*, Pyrenees; Embolite, Silver City, N. Mexico; *Jacobsite*, Jacobsberg, Sweden; *Fulgurites*, Thompson, Carroll Co., Ill.; Amphibole (*Edenite*), Edenville, N. Y.; *Arfvedsonite*, Greenland; *Forsterite* (Boltonite). Bolton, Mass.; *Gehlenite*. Mt. Monzoni; *Keilhauite*, Snarum, Sweden; *Catapleiite* and Astrophyllite, Norway; *Faujasite*, Baden; *Antillite*, Cuba; *Sipylite*, Amherst Co., Va; *Diabantite*, Bergen Hill, N J.; *Chalcosiderite*. Cornwall, England; *Arseniosiderite*, France; *Borikite*, Bohemia; *Bindheimite* (Bleinierite), England; *Howlite* from Gypsum, Hants, N. S.; *Warwickite*, Edenville, N. Y.; *Hübnerite*, Mammoth District, Nevada; *Cuproscheelite*, La Paz, Cal.; *Cyanotrichite*, Cape Garonne, France; *Dawsonite*, Montreal, Canada; *Schraufite*, Germany; Natrolite and three specimens of Apophyllite, Bergen Hill, N. J.; White Garnet, Hull, Quebec, Canada.

Rocks —Dr. H. C. Eckstein. Coal, with associated rocks, Green Harbor, Spitzbergen; Fossiliferous rock, Concretion Quartz, Green Harbor, Spitzbergen; Quartz, Mica-schist and Gneiss, Hammerfest, Norway.

E. S. Reinhold. Diorite (Napoleonite). American River, Cal.

Theo. D. Rand. Steatite with cavities formerly containing pseudomorphs of Serpentine after Staurolite, near Merion Square. Montgomery Co., Pa.; four lead casts of pseudomorphs of Serpentine after Staurolite; seven Rock specimens from neighborhood of Philadelphia: Actinolite, Wissahickon Creek, Phila; Actinolite decomposing, Wissahickon Creek, Phila.

Dr. Jos. Leidy. Twelve specimens showing natural jointed fracture, from the Potsdam Sandstone, South Mountain, near Wernerville, Bucks Co., Pa.; Black Hornstone pebble, with rhombs of Calcite, from the Delaware shore, Easton, Pa.; Granitoid pebbles, Quartz and Mica, from the gravel on the Almshouse ground, Phila.; Pebbles of Quartzite, from the gravel, Phila.; Pebble simulating a stone hammer, from the gravel of the University ground, W. Phila.; Probable Coprolite, Phosphate beds of Ashley River, S. C.

Dr. W. N. Whitney. Lava, Japan.

A. H. Smith. Rhomboidal pebble, from the gravel near Tinicum, Delaware Co., Pa.

A. Kollner. Ringing rock, Del Narrows, Bucks Co., Pa.; Rock containing Garnets, Bryn Mawr, Pa.

W. H. Harned. Calcareous Tufa with imbedded leaves, near Natural Bridge, Va.

J. M. Hartman. Serpentine and Chrysolite, Westville, N. J.; Serpentine, Del. Co, Pa.; Unakyte, French Broad, N. C.; Tremolite, Chile; Calcareous nodule.

ADDITIONS TO THE LIBRARY.

December 6, 1881, to December 26, 1882.

Abbot, H. Experiments and investigations to develop a system of submarine mines for defending the harbors of the United States. Engineer Corps, U. S. A.
Abbott, C. C. Primitive industry. The Author.
Allison, L. C. Discovery of Tripoli near St. John. The Author.
Angelin, N. P. Geologisk Öfversigts-Karta öfver Skäne. F. V. Hayden.
Balfour, F. M. Treatise on comparative embryology. II. Jos. Jeanes.
Baillon, M. H. Dictionaire de Botanique, 14me Fasc. I. V. Williamson Fund.
Natural history of plants. I. V. Williamson Fund.
Ball, V. Manual of the Geology of India. III. Economic Geology. Geological Survey of India.
Baltzer, A. Beiträge zur geologischen Karte der Schweiz, 20e Lief. Die mechanische Contact von Gneiss und Kalk im Berner-Oberland. With Atlas, 1880. F. V. Hayden.
Baraga, R. R., Bishop. A dictionary of the Otchipwe language, explained in English. II. Otchipwe-English. F. V. Hayden.
Barber, E. A. Pueblo pottery.
Antiquity of the tobacco-pipe in Europe. Pt. 2.
Catalogue of the collection of tobacco-pipes.
Mound pipes. The Author.
Barrande, J. Defense des Colonies. V.
Du maintien de la nomenclature établie par M. Murchison.
Acéphalés. Études locales et comparatives. The Author.
Bauerman, H. Text-book of systematic mineralogy, 1881. The Author.
Berg, Carlos. Contribuciones al estudio de las Cicadidæ de la Republica Argentina y paises limitrofes.
Sinonimia y descripcion de algunos hemipteros de Chile del Brasil y de Bolivia.
Farago lepidopterologica. The Author.
Bertrand, E. Note sur l'andalousite du Bresil.
De l'application du microscope à l'étude de la minéralogie.
Propriétés optiques de la Brochantite.
Sur les differences entre les propriétés optiques de corps crystallidés birefringents et celles que peuvent présenter les corps monorefringents.
Propriétés optiques de la Beudantite et de la pharmacosidérite.
Sur les cristaux pseudo-cubiques.
Étude optique des différents mineraux.
De l'application du microscope à l'étude de la minéralogie.
Sur les propriétés optiques des corps cristallises presentant la forme spherolithique.
Sur la leadhillite de Matlock. G. Vaux.
Bibliographie geologique et paléontologique de l'Italie, 1881. F. V. Hayden.
Bjorling, E. G. Fonctions elliptiques. The Westeräs Gymnasium.
Board of Health of the State of Louisiana. Annual report, 1881. The Board.
Bodleian Library. Donations to, 1881. The University of Oxford.
Boek, Axel. De Skandinaviske af arktiske Amphiopoder. Andet Hefte. University of Norway.
Bonpland, A. and A. Humboldt. Nova genera et species plantarum quas in peregrinatione ad plagan æquinoctialem orbis novi collegerunt descripserunt. 7 vols. text and 7 vols. atlas. Jos. Jeanes.

Borre, A. P. de. Description d'une nouvelle espèce de Buprestide, du genre Sternocera.
Sur les metamorphoses des Rhagium.
Du peu de valeur du caractère sur lequel a été établi le genre ou sous-genre Rhombonyx.
Sur le Carabus cancellatus et sa variété fusus.
Liste des Criocérides recueillies au Brésil par feu Camille van Volxem, suivie de la description de douze nouvelles espèces Americaines de cette tribu. The Author.
Boulenger. G. A. Catalogue of the Batrachia salientia S. ecaudata in the collection of the British Museum. 2d Ed. Trustees of the British Museum.
Boucard, A. On birds collected in Costa Rica.
Notes on some coleoptera of the genus Plusiotis. The Author.
Boué, A. Autobiographie du.
Bowerbank, J. S. Monograph of the British Spongiadæ. IV. Wilson Fund.
Brazier, J. Description of a new Bulimus from New Caledonia.
Helix pulchella and H. cellaria of Mueller, from Australia.
List of Cypræa found in Moreton Bay, Queensland.
Note on a specimen of malformed Cypræa.
Remarks on Megapodius Brazieri.
List of marine shells, collected on Fitzroy Island, North Coast of Australia.
A new variety of Bulimus Caledonicus.
Recent mollusca, found in Port Jackson, etc.
Localités des Isles Australiennes, etc. The Author.
Breidler, J., and J. B. Förster. Die Laubmoosflora von Oesterreich-Ungarn. Royal Zoologico-botanical Society of Vienna.
Brighton Health Congress. Transactions, 1881. The Mayor of Brighton.
British Museum. Catalogue of birds of the. VI. The Trustees.
Britton. N. L. Notes for botanists who have the preliminary catalogue of the flora of New Jersey. The Author.
Brogger. W. C. Die silurischen Etagen 2 und 3 im Kristianiagebiet und auf Eker. University of Norway.
Bronn, H. G. Klassen und Ordnungen des Thier-Reichs. 5er Bd., II Abth., 4–8 Lief.; 6er Bd., III Abth., 22–34 Lief.
Brooks W. K. Handbook of invertebrate zoology. Jos. Jeanes.
Brous, H. A. Notes on the habits of some western snakes. The Author.
Brown, Thos. Report of Inspector of Mines for Allegheny and Garrett Counties. 1881. The Author.
Brühl, C. B. Zootomie aller Thierklassen. Atlas, 23, 24, 25 Lief. I. V. Williamson Fund.
Brunner, Prof. Mineralogy of Berks, 9th paper. The Author.
Bucquoy, E., et Ph. Dautzenberg. Les mollusques marins du Roussillon. Fasc. 1er. I. V. Williamson Fund.
Bureau of Education. Circulars of information, Nos. 4, 5 and 6, 1881; No. 1, 1882. Department of the Interior.
Bureau of Ethnology. First annual report, 1879–80. The Smithsonian Institution.
Burmeister, H. Description physique de la Republique Argentine. Tomes 1, 2, 3 and T. 5, Pt. 1. Atlas 1e & 2e Livr. Premier section, Vues pittoresques. The Author.
Buxton, E. N. The A. B. C. of free trade. Cobden Club.
Cameron, P. Monograph of the British Phytophagus Hymenoptera. Wilson Fund.
Carpmael, C. Report of the Meteorological service of the Dominion of Canada. The Author.
Caswell, E. T. Reform in medical education the aim of the Academy. The Author.

Caton, J. D. The antelope and deer of America. Revised Ed. Jos. Jeanes.
Census Bulletin, No. 272. Department of the Interior.
Chambers, V. T. Antennæ and trophi of lepidopterous larvæ. The Author.
Chief of the Bureau of Statistics, Treasury Department. Quarterly report of, Dec. 31, 1881, to June 30, 1882
Annual report, 1881. Treasury Department.
Chief of Engineers, U. S. A. Annual report, 1881, Parts 1, 2 and 3.
Analytical index to reports of 1866–1879. Engineer Department, U. S. A.
Chief of Ordnance. Report of, 1881. War Department.
Chief Signal Officer. Annual report, 1879. War Department.
City Hospital of the City of Boston. Medical and surgical reports, 3d series, 1882. 18th report. The Editors.
City Library Association of the City of Springfield. Annual report, 1882. The Association.
Cocchi, J. Brevi cenni sui principali istituto e comitati geologici e sul R. Comitato Geologico d'Italia.
Descrizione geologica dell' Isola d' Elba per servire alla carta della medesima.
Racolta degli Oggetti de' cosi detti Tempi preistorici. G. Vaux.
Comas, D. Jaime Almera y. De Monjuich al Papiol al través de las épocas geológicas.
Estudis geologichs sobre la constitucio, origen .... de la Montanya de Montserrat. F. V. Hayden.
Commissioner of Agriculture. Annual reports, 1880 and 1881. The Department of Agriculture.
Commission de la Carte geologique de la Belgique. Renaix, Casterlé, Lille, Hérenthals, St. Nicholas and Tamise. Maps. The Commission.
Conférence Polaire internationale, Report sur les actes de la 3me. The Congress.
Cooke, J. P., Jr. On two new crystalline compounds of zinc and antimony.
The relation between the atomic weights of the chemical elements. G. Vaux.
Cope, E. D. Geology and Paleontology. From American Naturalist, August, 1882, and October, 1882.
Paleontological Bulletin, Nos. 34 and 35. The Author.
Coquand, H. Études supplémentaires sur paléontologie Algerienne. F. V. Hayden.
Cory, C. B. Birds of the Bahama Islands. The Author.
Costa, O. G. Paléontologia del Regno di Napoli. I, 1850; II, 1 and 2, 1854–56; III, 1857–63; Appendice I, 1866. Jos. Jeanes.
Cote est de Patagonie, 1881. F. V. Hayden.
Cox, J. C. Nomenclature and distribution of the genus Pythia. The Author.
Craven, A. E. Genre Sinusigera. The Author.
Credner, Hermann. Elemente der Geologie. Jos. Jeanes.
Dahll, T. Geologisk Kart over Nordlige Norge. University of Norway.
Dall, W. H. List of papers by. The Author.
Dana, Edward S. Third appendix to the 5th Ed. of Dana's Mineralogy. I. V. Williamson Fund.
Dana, J. D. The flood of the Connecticut River Valley from the melting of the quatenary glacier.
On the relation of the so-called "Kames" of the Connecticut River Valley to the terrace formation. The Author.
Darwin, Chas. The formation of vegetable mould through the action of worms. Jos. Jeanes.
Daubree, A. Etudes synthétiques de géologie expérimentale. Jos. Jeanes.
Debey, M. Sur les feuilles querciformes des sables d'Aix-la-Chapelle. The Author.
Delmas, J. Excursion dans la chaine des Maures. F. V. Hayden.

Department of Agriculture. Special report, Nos. 42–51. Dept. of Agriculture.
Department of Mines, Nova Scotia. Report, 1881. The Commissioner.
Department of Mines, N. S. W. Annual report, 1881. The Department.
Des Cloiseaux, M. Memoire sur une nouvelle localité d'Amblygonite et sur la Montebrasite. Geo. Vaux.
Deshayes, G. P. Description des animaux sans vertèbres. T. II, expl. des planches pp. 57 et seq. and text. T. III. Jos. Jeanes.
Dewalque, G. Prodrome d'une description géologique de la Belgique. 2d Ed. F. V. Hayden.
Dolley, C. S. Bacteria as beneficial and noxious agents. The Author.
Dorr, Dalton. Art museums and their uses. The Author.
Duncan, G. M. Somewhat about a few medicinal plants of New Brunswick. The Author.
Dupont, Ed. Sur l'origine des calcaires Devoniens de la Belgique.
Sur une revendication de priorite. The Author.
École national des Mines. Plan des galeries de mineralogie et de géologie. G. Vaux.
Elliot, D. G. Monograph of the Bucerotidæ. Pt. 9.
Monograph of the Felidæ. Pts. 8, 9 and 10. Wilson Fund.
Elliot, H. W. U. S. Com. Fish. Seal-Islands of Alaska. Department of the Interior.
Elliot, W. H. and F. H. Storer. On the impurities of commercial zinc. G. Vaux.
Encyclopædia Britannica, 9th ed. Vols. XIII and XIV. I. V. Williamson Fund.
Encyklopædie der Naturwissenschaften. 1e Abth., 25er and 2e Abth. 7 Lief. I. V. Williamson Fund.
Engelmann, G. The genus Isoëtes in North America. The Author.
Engler, A. Versuch einer Entwicklungsgeschichte der Pflantzenwelt. 2 Th. I. V Williamson Fund.
Erichson, W. F. Naturgeschichte der Insecten Deutschlands. 1e Abth. Coleoptera, 3er Bd. 2e Abth. 1e Lief. 6er Bd. 1e H. Wilson Fund.
Falsan A. Notice sur la vie et les travaux de Theophile Ebray. F. V. Hayden.
Fatio, V. Faune des vertébrés de la Suisse. IV, 1. I. V. Williamson Fund.
Fedtschenko, A. Reise in Turkestan. II, Zool. Th. 13 and 14; Th. III, Botanik, Th. 3. I. V. Williamson Fund.
Ferguson, T. B. Report of Commissioner of Fisheries of Maryland, 1881. J. A. Ryder.
Another copy. The Author.
Fernandez, Leon. Coleccion de documentos para la historia de Costa Rica. T. I. The Author.
Financial reform almanack, for 1882. Financial Reform Association.
Finley, J. P. Tornado studies for 1882.
Tornadoes. Their special characteristics and dangers. The Author.
Firket, A. Notice sur la Carte de la Production par Commune des Carrières de la Belgique pendant l'année, 1871.
Notice sur la carte de la production, de la consommation et de la circulation des minerais de fer, de zinc, de plomb et des pyrites en Belgique pendant l'année, 1871.
Étude sur les gites métallifères de la Mine de Landenne et sur la Faille Silurienne du Champ d'Oiseaux. F. V. Hayden.
Fischer, Paul. Manuel de conchyliologie. Fasc. 3 and 4. The Author.
Fischer, O. Physics of the earth's crust Jos. Jeanes.
Fish Commissioners of the State of Connecticut. 16th annual report. The Commissioners.
Flower, W. H. An introduction to the osteology of the mammalia. 2d Ed. Jos. Jeanes.
Förteckning pä Handskrifter in Westeras allm. Läroverks Bibliotek.
Forestry Bulletin, Nos. 18, 19, 20, 21 and 22. Dep. of Interior.

Foster, J. W. Pre-historic races of the U. S of America. 5th Ed., 1881. Jos. Jeanes.
Frazer, Persifor. Mémoire sur la géologie de la partie sud-est de la Pennsylvania. Proposition données par la faculté. Thèses. Lille, 1882. The Author.
Free Public Library, Museum and Walker Art Gallery of the City of Liverpool. 29th annual report. The Trustees.
Fries, Elia. Icones selectæ hymenomycetum nondum delineatorum. II, 1–6. Royal Swedish Academy of Sciences.
Gabelentz, G. v. d. Thai-Kih-Thu, des Tschu-tsi Tafel des Urprinzipes. F. V. Hayden.
Garbini, A. Apparechio della digestione nel Palæmonetes varians. The Author.
Gaston, J. M. F. Use of the ecraseur for curing deep-seated fistula in ano. The Author.
Gaudry, Alb. Les enchainement du monde animal dans les temps geologiques. Mammiferes tertiaires. Jos. Jeanes.
Geikie, Arch. Geological sketches at home and abroad.
Text-book of Geology. Jos. Jeanes.
Geological influences which have affected the course of British history.
Genth, F. A. Contributions to mineralogy, No. 20. The Author.
Geological and Natural History Survey of Canada. Report of progress for 1879–80. The Survey.
Geological Survey of New Jersey. Annual report, 1881. Topographical map of part of northern New Jersey. The Survey.
Geological Survey of India. Records, Vol. 14. Pts. 2, 3 and 4. Memoirs, 8vo. Vol. 18, Pts. 1, 2, 3. Memoirs, 4to. Palæontologia Indica. Series II, XI, XIII, 3; Ser. XIII, 1; Ser. XIV, Vol. 1, 3, Fasc. 1. The Survey.
Gilpin, Edw. The gold fields of Nova Scotia. The Author.
Goeppert, H. R. Arboretum fossile. Sammlung. F. V. Hayden.
Gosselet, M. J. Esquisse géologique du nord de la France. 1re Fasc. Texte and Plates.
Terrain diluvien de la Vallée de la Somme. F. V. Hayden.
Gould, John. Birds of Asia. Parts 32 and 33.
Birds of New Guinea. Part 12.
Supplement to the Trochilidæ or Humming Birds. Pts. 1 and 2. Wilson Fund.
Gozzadini, G. Il sepolcreto di Crespellano nel Bolognese.
Di un utensile tratto dalla necropoli Felsinea.
Di un sepolcri e di un frammento ceramico della Necropoli Felsinea.
Note archeologiche per una guida dell'Apennino Bolognese. F. V. Hayden.
Grandidier, Alf. Histoire physique, naturelle et politique de Madagascar. Tome XII, XIV and XV. I. V. Williamson Fund.
Gray, Asa. Contributions to North American botany. The Author.
Guiscardi, G. Il piperno. G. Vaux.
Günther, A. C. L. G. Gigantic land-tortoises (living and extinct) in the collection of the British Museum, 1877. Jos. Jeanes.
Guldberg, C. M. et H. Mohn. Études sur les mouvements de l'atmosphère. 2me partie. University of Norway.
Haeckel, E. Monographie der Medusen. 2er Th. 1e and 2e Halfte, with Atlas. I. V. Williamson Fund.
Hall, Jas. Fossil coal of the Niagara and Upper Helderberg Groups. The Author.
Harper, G. W. and A. G. Wetherby. Catalogue of the land and fresh-water mollusca found in the immediate vicinity of Cincinnati, O. A. G. Wetherby.

Harrison, W. J. Geology of the counties of England and of North and South Wales. Jos. Jeanes.
Hartmann. W. D. Species of the genus Partula. The Author.
Haswell, Wm. A. The Australian Museum. Catalogue of the Australian Stalk- and Sessile-eyed Crustacea. Trustees of the Museum.
Hauer, Fr. v. and M. Neumayer. Führer zu den Excursionen der deutschen geologischen Gesellschaft nach der allgemeinen Versammlung in Wien, 1877. The Authors.
Haughton, Rev. S., Six lectures on physical geography. Jos. Jeanes.
Hautefeuille, M. Étude sur la cristallisation de la silice par la voie sèche. Geo. Vaux.
Hay, G. U. Memorial sketch of Prof. Ch. Fred. Hart. The Author.
Heer, O. Die Insektenfauna der Tertiargebilde von Oeningen und von Radoby in Croatien. 1, 2 und 3er Th. Jos. Jeanes.
Herbert, S. The camel. The Author.
Herman, O. Ungarns Spinnen Fauna. II Bd. Hungarian National Museum.
Hermann, L. Handbuch der Physiologie. IV, 2. I. V. Williamson Fund.
His, W. Anatomie menschlicher Embryonen. II. I. V. Williamson Fund.
Hovey, Rev. H. C. Discoveries in western caves. G. Vaux.
Hutton, F. W. Contributions to New Zealand Malacology.
On the New Zealand Hydrobiinæ. The Author.
Huxley, T. H. Critiques and addresses, 1873.
Lay sermons, addresses and reviews, 1880.
Science and culture and other essays, 1882. Jos. Jeanes.
Inostranzeff, A. Ein neues, äusserstes Glied in der Reihe der amorphen Kohlenstoffe. F. V. Hayden.
Internationale Fischerei-Ausstellung in Berlin im Jahre 1880. Italianische Abtheilung.
I petrolii in Italia, 1877. F. V. Hayden.
Jackson, B. D. Vegetable technology. Thos. Meehan.
Jackson, J. Liste provisoire de bibliographies géographiques spéciales. F. V. Hayden.
Jacquin, J. Plantarum rariores Horti Caesarei Schoenbrunnensis. 4 vols., 1879. Jos. Jeanes.
Jan, Prof. Iconographie générale des Ophidiens, 50me Livr. Wilson Fund.
Jannetaz, E. Guide to the determination of rocks. Jos. Jeanes.
Jeffreys, J. Gwynn. On the mollusca procured during the Lightning and Porcupine Expeditions, 1868–70. The Author.
Johanson, C. H. Odonata Sueciæ. The Westeräs Gymnasium.
Johnson, A. B. Aberrations of audibility of fog signals. The Author.
Jourdan, E. Contribution a l'étude de lymphorrhagies. F. V. Hayden.
Just, L. Botanischer Jahresbericht. VI, 1e Abth. 2 H.; 2 Abth. 2 und 3 H. VII, 1e Abth. 1; 2e Abth. 1. I. V. Williamson Fund.
Karrer, F. Der Boden der Hauptstädte Europa's. F. V. Hayden.
Kiepert, H. Special-Karte des Türkischen Armeniens. F. V. Hayden.
King, C. First annual report of the U. S. Geological Survey. Department of the Interior.
Kirby, W. F. List of hymenoptera, with descriptions and figures of the typical specimens in the British Museum. Vol. 1, Tenthredinidæ and Siricidæ, 1882. The Trustees.
Kjerulf, Theo. Die Geologie des südlichen und mittleren Norwegens. F. V. Hayden.
Knapp, F. Die doleritischen Gesteine des Frauenberges bei Schlüchtern in Hessen. F. V. Hayden.
Kobelt, W. Catalog der Gattung Neptunea.
Die mauritanischen Iberus. The Author.

Kokscharow, N. v. Materialien zur Mineralogie Russlands. 8er Bd., Bg. 9-20. I. V. Williamson Fund.
Koldeway. Die 2e deutsche Nordpolarfahrt, 1867-70. 2er Bd. F. V. Hayden.
Konnick, L. G. de. Sur quelques céphalopodes nouveaux du calcaire carbonifère de l'Irlande. The Author.
K. K. Geologische Reichsanstalt. Catalog der Ausstellungsgegenstände bei der Wiener Weltausstellung. The Society.
Künckel d'Herculais, J. Recherches sur l'organisation et le dévelopment des Diptères. 2me Partie. I. V. Williamson Fund.
Lapparent, A. de. Traité de geologie. Fasc. 1-6. Jos. Jeanes.
Lartet, E. Vie et traveaux de. F. V. Hayden.
Lawes, J. B., J. H. Gilbert and R. Warington. On the amount and composition of the rain and drainage-waters collected at Rothamsted. The Authors.
Lewis, H. C Antiquity and origin of Trenton gravels.
On a new substance resembling Dopplerite from a peat bog at Scranton.
Note on the aurora of April 16-17, 1882.
Mineralogical notes, May and June, 1882.
Mineralogical notes, Jan., Feb. and Oct., 1882. The Author.
Library Company of Philadelphia, Bulletin, n. s., Nos. 8 and 9. The Directors.
Library of the Surgeon General's Office. Index catalogue, vol. 3. War Department.
Light House Board. Annual report, 1881 and 1882. Treasury Department.
Lists of the minerals and fossils selected from the main collection in the Museum of the Mining School at St. Petersburg for exhibition at Philadelphia, 1876. G. Vaux.
Liverpool Free Public Library. Catalogue of the. The Library Committee.
Liversidge, A. List of scientific papers and reports by. The Author.
Locard, A. Guide du géologie a la nouvelle Chapelle de Fourvières.
Notice sur Gaspard Michaud sa vie et ses œuvres.
Note sur les pluies de Boue dans la région Lyonnaise.
Nouvelles recherches sur les argiles lacustres des terrain quaternaires des environs de Lyon. F. V. Hayden.
Loretz, H. Untersuchungen über Kalk und Dolomite. I and II.
Ueber Schieferung.
Ueber Transversalschieferung und verwandt Erscheinungen im thüringischen Schiefergebirge.
Notizen über Buntsandstein und Muschelkalk in Süd-Thüringen.
Beitrag zur geologischen Kenntniss der cambrisch-phyllitischen Schieferreihe in Thüringen. The Author.
Lubbock, Sir J. Ants, bees and wasps. Jos. Jeanes.
Lubbock, Rev. R. Observations on the fauna of Norfolk and more particularly on the district of the Broads. F. V. Hayden.
Lyell, Chas. Students' elements of geology, 3d Ed. Jos. Jeanes.
Macagno, L. Provve dimenti contro la fillossera.
Sull Ispezione ai vigneti della Liguria. The Author.
Macpherson, J. Estudio geologico y petrografico del morte de la Provincia de Sevilla. F. V. Hayden.
Maderspach, L. Magyarország Vasercz-Fekhelyei, 1880. Hungarian National Museum.
Mantovani, P. La Piogia di genere caduta a Napoli e la lava dell' eruzione del Vesuvio dell' Aprile 1872.
Sulla formazione geologica delle colline presso Ancona.
Un escursione al Vesuvio durante l' eruzione del 1871.
Descrizione geologica della Campagna Romana. G. Vaux.
Marion, M. A. F. Application du sulfure de carbone au traitement des vignes phylloxerees. Campagne de 1878 & 4e Annee. F. V. Hayden.

Marschall, F. and A. v. Pelzeln. Ornis Vindobonensis. F. V. Hayden.
Marsh, O. C. The wings of pterodactyles. The Author.
Martens, E. v. Conchologische Mittheilungen, 1 and 2. I. V. Willamson Fund.
Martin, K. and A. Weichmann. Sammlungen des geologischen Reichs Museums in Leiden. I. Beiträge zur Geologie Ost-Asiens und Australiens. F. V. Hayden.
Martini und Chemnitz. Systematisches Conchylien-Cabinet, 308–317 Lief. Wilson Fund.
Martins, C. F. P. de. Flora Brasiliensis, Fasc. 83. Asa Gray.
Mason, J. J. Minute structure of the central nervous system of certain reptiles and batrachians of America. Series A. The Author.
Materiali per la Carta geologica della Svizzera. XVII. Appendice ed Indice. F. V. Hayden.
Mayer, Chas. Tableau synchronistique des terrain crétacés. Terrains tertiaires. Terrain jurassique.
Fossiles des terrains tertiaires qui se trouvent au Musée fédéral de Zurich. 1er Cahier. Jos. Jeanes.
Medley, Geo. W. England under free trade. Cobden Club.
Meneghini, G. Della Scuola geologica di Paola Savi. F. V. Hayden.
Mercantile Library Association of the City of New York. 61st annual report, 1881–82. The Directors.
Mercantile Library Association, San Francisco. 23d annual report. The Trustees.
Mercantile Library Company. 59th annual report. The Directors.
Meyer, A. B. Ueber hundert fünfunddreissig Papua-Schädel von Neu-Guinea und der Insel Mysore.
Die Kalangs auf Java. F. V. Hayden.
Meyer, A. B. und E. Tüngel. Verzeichniss der Race-Skelete und Schädel des Dresdner anthropologischen Museums.
Anthropologische Mittheilungen über die Papuas von Neu-Guinea.
Neu-Guinea. F. V. Hayden.
K. Ethnologisches Museum zu Dresden. I. Bilderschriften des Ostindischen Archipels und der Südsee. The Museum.
Mivart, St. G. The Cat., 1881. Jos. Jeanes.
Moissenet, M. L. Memoire sur un nouveau fluophosphate. G. Vaux.
Moleschott, Jac. Untersuchungen zur Naturlehre des Menschen und der Thiere. XIII, 1. I. V. Williamson Fund.
Mongredien, Aug. Pleas for protection examined. Cobden Club.
Moore, F. Description of new Indian lepidopterous insects from the collection of the late Mr. W. S. Atkinson. Part II. Heterocera, continued. The Author.
Morris, Chas. Organic physics. The Author.
Mueller, Ferd. v. On the development of rural industries.
Eucalyptographia. Decades 1, 3, 4, 7 and 8. The Author.
Müller, Jos. Gasteropoden der Aachener Kreide.
Beitrage zur Petrefactenkunde der Aachener Kreide.
Monographie der Petrefacten der Aachener Kreideformation. 1 and 2 Abth.
Neue Beitrage zur Petrefacten der Aachener Kreideformation. Jos. Jeanes.
Myers, W. W. Filaria sanquinis hominis in S. Formosa. The Author.
Nachtigal, G. Sahara and Sudan. 2er Th. I. V. Williamson Fund.
Nagle, J. T. Summary of births, marriages, still-births and deaths in New York City during the year 1880. N. Y. Health Department.
Negris, B. Patologia vegetale. The Author.
Nevill, Wm. Descriptive catalogue of minerals. G. Vaux.
Newberry, J. S. Genesis and distribution of gold.
Hypothetical high tides as agents of geological change.
The origin and relation of the Carbon Minerals. The Author.

New South Wales. Australian Museum, report, 1881. The Trustees.
Nitzsch. Zoology. Manuscript, 1828. Graceanna Lewis.
Norske Nordhavs-Expedition, 1876–78. IV and V. The Norwegian Government.
Novitates Conchologicæ. I Abth. Land-Conchylien, 50 and 57 Lief. Supl. VII. Wilson Fund.
Ochsenius, C. Geologisches and montanistisches aus Utah.
Ueber Petrolium-Bildung. The Author.
Oerley, L. Monographie der Anguillulidea. Hungarian National Museum.
Oudemans, J. A. C. Commission géodésique Néerlandaise. I. Determination, à Utrecht de l'azimut d'Amersfoort. The Commission.
Paget, Sir James. Descriptive catalogue of the pathological specimens contained in the Museum of the Royal College of Surgeons of England. Vol. 1. General pathology. The College.
Palæolithic implements of the valley of the Delaware. Boston Society of Natural History.
Palæontographica. 28er Bd. 3e, 4e–6e Lief. 29er Bd. 1e L. Wilson Fund.
Paléontologie Francaise. 1le Ser. Ter. Juras. Livr. 47–53. An. Invert. Wilson Fund.
Palæontographical Society's Publications. Vol. 36. Wilson Fund.
Palmieri, L. Description du Seismographe électro-magnétique. G. Vaux.
Panceri, P. Ricerche sugli organi che nei gasteropodi segregano l'acido solforico. The Author.
Parish, S. B. and W. F. Plants of Southern California. The Authors.
Payot, V. Geologie et mineralogie des environs du Mont-Blanc.
Catalogue de la série des roches de la chaine du Mont-Blanc. G. Vaux.
Pennsylvania Museum and School of Industrial Art. 6th annual report. The Trustees.
Peters, W. C. H. Naturwissenschaftliche Reise nach Mossambique. Zoologie, 3. Amphibien I. V. Williamson Fund.
Petri ab Hartenfelz, D. Geo. Christ. Elephantographia curiosa. Lipsiæ, 1723. John H. Swaby.
Philippi, F. Catalogus plantarum vascularium Chilensium. F. V. Hayden.
Photograph of the tail of a rattle-snake. G. W. Fox.
Picard-Cambridge, Oct. Spiders of Dorset. Vol. 1. Rev. Henry C. McCook.
Same. Vol. 2. I. V. Williamson Fund.
Plateau, F. Préparation rapide des grandes pieces Myologiques. The Author.
Portis, Ales. Sui terreni stratificati di Argentera. F. V. Hayden.
Powell, J.W. Contributions to N. A. ethnology. IV. Department of the Interior.
Powers, H. N. Annual address before the Bridgeport Scientific Society. The Author.
Prantl, K. Untersuchungen zur Morphologie der Gefässkryptogamen. 2 H. I. V. Williamson Fund.
Price, Eli K. Rockery at the University of Pennsylvania built in 1881. The Author.
Procter, Wm., Jr. A memorial of Elias Durand. G. Vaux.
Public Library of Victoria, catalogue, 2 vols., 1880. The Trustees.
Putnam, F. W. Archæological explorations in Tennessee.
Mounds at Meron and Hutsonville on the Wabash. G. Vaux.
Sketch of the Hon. Lewis H. Morgan. The Author.
Quaritch, B. Catalogue of books on natural history. The Publisher.
Reinhardt, J. Naturforskeren Peter Wilhelm Lund. F. V. Hayden.
Renevier, E. Orographie de la partie des Hautes-Alpes calcaires comprise entre le Rhône et le Rawyl. F. V. Hayden.
Rivière, E. Nouvelles recherches dans les Alpes-Maritimes.
La grotte de l'Albaréa. The Author.
Ranvier, L. Traité technique d'histologie, 6me Fasc. I. V. Williamson Fund.
Reclus, Élisée. Nouvelle geographie universelle, 359e–417e. F. V. Hayden.

Reichenbach, H. G. Xenia Orchidacea. 3er Bd., 2es H. Wilson Fund.
Reinsch, P. F. The composition and microscopical structure of coal. The Author.
Reported mortality for the year ending Dec. 31, 1880. Health Department, N. Y.
Ribeiro, C. Estudos prehistoricos em Portugal. F. V. Hayden.
Richthofen, F. Freih. v. China, 2er Bd. I. V. Williamson Fund.
Riley, C. V. Little-known facts about well-known animals. The Author.
Robert, H. M. Map showing the location of works and surveys for river and harbor improvement. Engineer Department, U. S. A.
Robert, P. Les oiseaux dans la nature. Livr. 21–30. I. V. Williamson Fund.
Rossiter, R. C. A list of Cypræidæ found on the coast of New Caledonia and Loyalty Islands. The Author.
Ruiz, H. and J. Pavon. Flora Peruviana et Chilensis, 4 vols., 1798. Jos. Jeanes.
Russ, K. Die fremdländischen Stubenvögel. IV, 2. I. V. Williamson Fund.
Ryder, J. A. Planarians parasitic on Limulus.
Structure and ovarian incubation of Gambusia patruelis.
Additional note on the egg-cases of Planarians ectoparasitic on Limulus. The Author.
St. Louis Mercantile Library Association, annual report, 1882. The Trustees.
Sandberger, F. Zur Naturgeschichte der Rhön. F. V. Hayden.
Saporta, G. de and A. F. Marion. L'evolution du regne végétal.
Les cryptogames. F. V. Hayden.
Sars, G. O. Carcinologiske Bidrag til Norges Fauna. I, 8. University of Norway.
Saussure, H. La question du lac. F. V. Hayden.
Schaufuss, L. W. Molluscorum systema et catalogus. The Author.
Scheffler, H. Das Wesen der Elektrizität des Galvanismus und Magnetismus. 2es Suppl. zum zweiten Theile der Naturgesetze. The Author.
Schenzl, G. Beiträge zur Kenntniss der erdmagnetischen Verhältnisse in den Ländern der Ungarischen-Krone. Hungarian National Museum.
Schiödte, J. C. Zoologia Danica. 2et Hefte. I. V. Williamson Fund.
Schmidt, A. Atlas der Diatomaceen-Kunde, 19 und 20 H. I. V. Williamson Fund.
Schmidt, E. Mittheilungen a. d. anthropologischen Literatur Amerikas. The Author.
Schomburgk, A. Report on the progress and condition of the Botanic Garden and Government Plantations during the year 1881. The Author.
Schrenck, L. v. Reisen und Forschungen im Amur-Lande. Bd. III, 1e Lief. Wilson Fund.
Scudder, S. H. Fragments of the coarser anatomy of diurnal lepidoptera. The Author.
Schübeler, F. C. Væxtlivet i Norge med saerligt hensyn til plantegeographien. University of Norway.
Second Geological Survey of Pennsylvania, report, C^6. The Survey.
Semper, C. Reisen im Archipel der Philippinen, 2er Th., 2er Bd. Supplement-Heft III. Wilson Fund.
Sheridan, P. H. Record of engagements with hostile Indians with the Military Division of the Missouri from 1868 to 1882. The Author.
Shufeldt, R. W. Remarks upon the osteology of Opheosaurus ventralis. The Author.
Siebke, H. Enumeratio Insectorum Norvegicorum, Fasc. V. University of Norway.
Siebold, C. de. Novella lettera di, sulla partenogenesi del Bombix Mori. The Author.
Skalkovsky, C. Tableaux statistiques de l'Industrie des Mines en Russie en 1868. G. Vaux.
Smith, J. L. On the minerals of the Wheatley Mine in Pennsylvania. G. Vaux.
Smithsonian Institution, annual report, 1880. The Institution.

Societa Entomologica Italiana. Resoconto delle adunanze generali e parziali per l'anno 1872. II and III. The Society.
Société zoologique de France. De la nomenclature de etres organises. The Society.
South African Museum, report of Trustees, 1881. The Trustees.
Sowerby, G. B. Thesaurus Conchyliorum, Pts. 37 and 38. Wilson Fund.
Speyer, O. Die Conchylien der Casseler Tertiärbildungen, 7e Lief. Jos. Jeanes.
Standard time for the United States of America, Canada and Mexico. American Society of Civil Engineers.
Stanley, W. F. Properties and motions of fluids. 1881. The Author.
Stazione di Entomologia agraria fondata in Firenze. 1875.
Stearns, R. E. C. On certain aboriginal implements from Napa County, Cal.
On the growth of certain California forest trees.
Forest tree culture in California.
Verrillia blakei or Halipteris blakei.
The acorn-storing habit of the California woodpecker.
Remarks on the death of Hon. B. B. Redding. The Author.
Stoppani, Ant. Paléontologie Lombarde. Livr. 56 and 57. Wilson Fund.
Il bel Paese. II Ed. F. V. Hayden.
Strebel, H. Beitrag zur Kenntniss der Fauna mexikanischer Land- und Süsswasser-Conchylien. Th. V. I. V. Williamson Fund.
Struckmann, C. Ueber die Verbreitung des Renthiers in der Gegenwart und in älterer Zeit nach Massgabe seiner fossilen Reste unter besonderer Berücksichtigung der deutschen Fundorte.
Die Insel Rügen Reise-Erinnerungen. F. V. Hayden.
Sur l'uniformité de la nomenclature des grandes divisions de l'écorce terrestre. F. V. Hayden.
Symons, T. W. Report of an examination of the Upper Columbia River and the territory in its vicinity. War Department.
Szabo, J. and S. Török. Album of the Tokay-Hegyalja, 1867. Dr. Jos. Szabo.
Taramelli, T. Monografia stratigrafica e paleontologica del Lias nelle Provincie venete.
Osservazioni geologiche. 1882
La carta geologica d' Italia. The Author.
Targioni-Tozzetti, A. Catalogo della collezione di insetti Italiani del R. Museo di Firenze Serie 1 and 2, Coleotteri.
Parasiti del gelso e dell' Olivo.
Osservazioni sulla Fillossera del Leccio e della Querce.
Ancora sulla melata e la sua origine.
Gli uccelli, gli insetti parasiti e le trattative per gli accordi internazionali intorno alle leggi di Caccia.
Bibliographia botanica Targioniana, 1874.
Animali riportati dalle escursione nelle provincie meridionale in Sicilia e in Sardegna negli anni 1868–1869.
La bocca ed i piedi dei Tetranychus.
Myxolecanium Kibarae Beccari.
Nota anatomiche intorno agli insetti.
Orthopterorum Italiae species novae in collectione R. Musei Florentini.
Osservazioni di entomologia agraria.
Estratto di un catalogo sistematico e critico dei Molluschi Cephalopodi del Mediterraneo.
Relazioni sulla pesca a S. E. il Ministro di Agricultura industria e commercio.
Sunto della conferedza sulla fillossera.
Sulla Helicopsyche agglutinans Tass.
Discorso inaug. letto nella prima adunanzia publica della Societa Entomologica Italiana.

Riassunto ed emendamento dei prospetti dei generi e delle specie degli ortotteri secondo la fauna Italiana.
Catalogo di Crostacei Podottalmi Brachiueri e Anomouri raccoli nel viaggio di circumnavigazione della Fregata Italiana Magenta.
Sugli effetti naturali della Caccia e sulla ragioni e la opportunita degli ordini per regolarne l' esercizio.
Sostanze alimentari all' esposizioni di Londra nel 1862.
Sopra alcuni lepidotteri parassiti dell' Uva, dell Grano Turco, ecc. e sulla Helicopsyche ottenuta allo stato d' immagine.
La fillossera a Valmadrera.
Delle forfecchie, riattole, grillatalpe, grilli, locuste e cavallette nella economia domestica e nella pratica agraria.
Notizie sulla fillossera della Viti.
Sopra due generi di cogginiglie (Coccidæ) e sui criteri della loro definizione.
Commentario sui cephalopi Mediterranei del R. Museo di Firenze.
Sulla composizione delle Zampe del Gyrinus notator.
La lotta contro la fillossera in Isvizzera.
Di una specie nuova in un nuova genere di Cirripedi lepadidei ospitante sulle penne addominali del Priofinus cinereus.
Sulla sezione pesci salati e in conserva quale era rappresentata all Esposizione Universale di Vienna nel giugna 1873. The Author.

Tate, R. and J. Brazier. Check list of the fresh-water shells of Australia. J. Brazier.
Thomson, J. H. Specific distinctness of Helix (Mesodon) Chilhoweensis. The Author.
Toula, F. Ueber den gegenwärtigen Stand der Erdbebenfrage.
Ueber die secularen Hebungen und Senkungen der Erdoberfläche. F. V. Hayden.
Trautschold, H. Ueber den muthmasslichen Geschlechtsapparat von Poteriocrinus multiplex.
Trautvetter, E. R. a., E. L. Regel, C. J. Maximowicz and K. J. Winkler. Decas plantarum. The Authors.
Trinius, D. C. B. Species graminum. Fasc. 28. Jos. Jeanes.
Tryon, Geo. W., Jr. Manual of Conchology, XIII–XVI. The Author.
Tyndall, J. Essays on the floating matter in the air in relation to putrefaction and infection. Jos. Jeanes.
United States Coast Survey. Methods and results of the currents and temperature of Bering Sea. Appendix 16, Report 1880. The Coast Survey.
U. S. Commission of Fish and Fisheries. Report, 1879. The Commission.
U. S. Entomological Commission. Bulletin No. 7. Department of the Interior.
U. S. Geographical Surveys west of the 100th mer., Report upon. Vol. 3, Supplement, Geology. Engineer Dep. U. S. A.
U. S. Geological and Geographical Survey of the Territories. Vol. VI, No. 3. Department of the Interior.
U. S. National Museum. Bulletin 14, 15, 17, 18 and 21. Department of the Interior.
University Library, Cambridge. 28th annual report. The University.
University of Mississippi. Catalogue of officers and students, 30th session. The Trustees.
University of Wurzburg. Eighteen theses of the medical and philosophical faculties. The University.
Van der Horn van den Bos, H. P. M. Die Nederlandsche Scheikundigen van het Laatst der vorige Eeuw. Utrecht Society of Natural Sciences.
Victoria. Reports of the Mining Surveyors and Registrars, 30th Sept., 1880, 31st March, 30th June and 30th Sept., 1881. Mineral Statistics, 1880. F. V. Hayden.

Villa, A. and G. B. Cenni Geologici sul territorio dell' Antico distretto di Oggiono. F. V. Hayden.
Wadsworth, E. Notes on the mineralogy and petrography of Boston and vicinity. Geo. Vaux.
Wadsworth, M. E. On the relation of the Quincy granite to the primordial argillite of Braintree, Mass.
Some points relating to the geological exploration of the 40th parallel. The Author.
Wallace, A. R. Island life, 1881. Jos. Jeanes.
Watson, Rev. R. B. Mollusca of H. M. S. "Challenger" Expedition, 8–14. The Author.
Weisse, J. F. Die diatomaceen des Badeschlammes von Arensburg und Hapsal.
Zur oologie der Raderthiere, 1862. G. Vaux.
Wetherby, A. G. Notes on American land shells, Nos. 1 and 2.
On the geographical distribution of certain fresh-water mollusks of North America, Nos. 1 and 2.
On the deformities of some Tennessee Helices.
Notes on some new or little known North American Limnæidæ.
Review of the genus Tulotoma, with remarks on the geographical distribution of North American Viviparidæ. The Author.
Wex, Gustav. Decrease of water in springs, creeks and rivers. Engineer Department, U. S. A.
Whitfield, R. P. Descriptions of new species of fossils from Ohio. The Author.
Williams, H. S. Recurrence of faunas in the Devonian rocks of New York. The Author.
Williams' tourist's map of Colorada. F. V. Hayden.
Winchell, N. H. Geological and natural history survey of Minnesota. 9th annual report. The Author.
Wright, G. F. Age of the palæolithic-bearing gravels of Trenton. The Author.
Yarrell, Wm. History of British Birds. 4th Ed. Pt. 14. I. V. Williamson Fund.
Zacharias, O. Chas. R. Darwin und die culturhistorische Bedeutung seiner Theorie vom Ursprung der Arten. I. V. Williamson Fund
Zecchini, S. P. L' azione fatale dell' uomo sulla terra. The Author.
Zeledon, J. C. Catalogo de la Aves de Costa Rica. The Author.
Zittel, K. A. Handbuch der Palæontology. I, 2 Abth. 1 Lief. I. V. Williamson Fund.
Zoological Record, 1880. Wilson Fund.
Zoologische Station zu Neapel. Fauna und flora des Golfes von Neapel. Monog. I–IV. I. V. Williamson Fund.

Journals and Periodicals.

Altenburg. Verein für Naturwissenschaft zu Braunschweig. Jahresbericht, 1881. The Society.
American Association for the Advancement of Science. Proceedings, Vols. 29 and 30. The Society.
Amsterdam. K. Akademie van Wettenschappen. Verslagen en Mededeelingen, Afd. Letterkunde, 2e Reeks, 10 Deel. Afd. Natuurk., 2e Reeks, 16 Deel. Jaarboek, 1880. Processen-Verbaal, Afd. Nat, 1880–1881. Verhandlengen, Deel 21. The Society.
Angers. Société nationale d'Agriculture, Sciences et Arts. Mémoires, T. 22 et 23. The Society.
Anvers. Société de Géographie. Bulletin, IV, 7; V, 1–7; VI, 1–4, 6–8. Dr. F. V. Hayden.
Auch. Société Française de Botanique. Revue de Botanique, I, 1. The Society.
Augsburg. Naturhistorischer Verein. 26er Bericht. The Society.

Auxerre. Société des Science historiques et naturelles de l'Yonne. Bulletin, 35e Vol. The Society.

Baltimore. American Chemical Journal, I, 1—IV, 4. The Editor.
American Journal of Mathematics, IV, 1—V, 1. Johns Hopkins University.
Johns Hopkins University. Studies from the Biological Laboratory, II, 2, 3; Report 5th and 6th; University Circulars Nos. 11-17. The Editor.
Peabody Institute. 15th annual report. The Trustees.

Bamberg. Naturforschende Gesellschaft. 12er Bericht. The Society.

Basel. Naturforschende Gesellschaft. Verhandlungen, 7er Th. 1. The Society.

Belfast. Natural History and Philosophical Society. Proceedings, Sessions 1879-80, 1880-81. The Society.

Berlin. Archiv für Naturgeschichte, 24er Jahrg., 6; 47er Jahrg. 6—48er Jahrg. 3. The Editor.
Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte. Verhandlungen, 1880, Nov. 7—1881, März 19.
Zeitschrift für Ethnologie, 1871, 1-3, 5, 6; 1872; 1873, 1, 3-6; 1874; 1875, 2-6; 1876-1879. Dr. F. V. Hayden.
Entomologischer Verein. Deutsche entomologische Zeitschrift, 25er Jahrg. 2es H.. 26er B. 1es H. The Society.
Deutsche geologische Gesellschaft. Zeitschrift, XXXIII, 2—XXXIV, 1. The Society.
Gesellschaft naturforschender Freunde. Sitzungsberichte, 1881. The Society.
K. Preussische Akademie der Wissenschaften. Monatsbericht, 1881, Juli–Dec. Abhandlungen, mathematische, 1880; physikalische, 1881. Sitzungsberichte, 1-38. The Academy.
Linnæa 43er Bd., 5, 6, 7. Jos. Jeanes.
Der Naturforscher, XIV, 27-XV, 26. The Editor.
Naturæ Novitates, 1881, Nov. 23-1882, Nov. 20. The Publishers.
Verein zur Beförderung des Gartenbaues. Monatsschrift. 24er Jahrg., Jan -Dec. The Society.
Zeitschrift für die gesammten Naturwissenschaften, 3e Folge, III, 6. The Editor.

Bern. Naturforschende Gesellschaft. Mittheilungen, Nos. 1004-1029. The Society.

Besançon. Académie des Sciences, Belles-Lettres et Arts. 1879-80. The Society.

Bistritz. Gewerbeschule. Jahresberichte 7er und 8er. The Director.

Bologna. Academia delle Scienze. Memoire, ser. IV, T. 1 et 2. Volume Unico, 1881. The Society.

Bonn. Archiv für mikroskopische Anatomie, XX, 3—XXI, 4. I. V. Williamson Fund.
Naturhistorischer Verein. Verhandlungen, 38er Jahrg. 2es H. The Society.

Bordeaux. Société Linnéenne. Actes, T. 35me. The Society.
Société des Science physiques et naturelles. Mémoires, IV, 3. The Society.

Boston. American Academy of Arts and Sciences. Memoirs, X, 2; XI, 1. The Society.
New England Journal of Education, IX. 25, 27; X, 1-4, 6-9, 10-23; XI, 1-7, 9-25; XII, 1-26; XIII, 1-13, 18-20. F. V. Hayden.
Scientific and Literary Gossip, I, 2, 3. The Editor.
Society of Natural History. Proceedings, XXI. pp. 129-240, 257-432; XXII, pp 1-16. Another copy, XX, Pt. 4; XXI, 1, 2 and 3. Memoirs, Vol. 3, Pt. 1, Nos. 4 and 5. The Society.
Zoological Society. Quarterly Journal, I, 2. The Society.

Braunschweig. Archiv für Anthropologie. 13er Bd. 4es Heft, and Supplement; 14er Bd. les und 2es H. I. V. Williamson Fund.
Bremen. Naturwissenshaftliche Verein. Abhandlungen VII, 3. The Society.
Brünn. Naturforschende Verein. Verhandlungen, XIX. The Society.
Bruxelles. Société Belge de Géographie. Bulletin, 1880, Nos. 2–6. F. V. Hayden.
Société Belge de Microscopie. Bulletin, 1881, Oct.—1882, Juin. The Society.
Société Malacologique. Procès-verbaux, 1880, Nov.—1882, Jan. The Society.
Société Entomologique. Annales XXV, Statuts 1882. The Society.
Budapest. Földrajzi Közlemenyek. X, 4 and 5; XI, 2 and 4. F. V. Hayden.
K. U. Central-Anstalt für Meteorologie und Erdmagnetismus. Jahrbuch IX. F. V. Hayden.
M. Tudom. Akademia. Ertekezesek a Math. Tudományok Köréböl, VIII, 1–6, 8–12; X, 19–25; XI, 1–26, Math. es Termeszet. Közlemenyek, XVII.
Ungarische Revue, 1881, H, 5–12; 1882, H, 1–6. The Society.
Ungarische National-Museum. Természetrajzi Füzetek, V, 2–4. The Museum.
Buenos Aires. Museo publico. Anales, Ent. 2, 12. The Director.
Buffalo. American Society of Microscopists. Proceedings, 4th an. meeting. The Society.
Society of Natural History. Bulletin, IV, 2, 3. The Society.
Caen. Académie nationale des Sciences, Arts et Belles-Lettres. Mémoires, 1881. The Society.
Société Linnéenne de Normandie. Bulletin, 3e Série, T. 4me. The Society.
Cairo. Société Khediviale de Geographie. Bulletin, Nos 7–12. F. V. Hayden.
Calcutta. Asiatic Society of Bengal. Journal, L, Pt. 1, Nos. 1–4; Pt. 2, Nos. 1–4; XLIX, extra number to Pt. 1; LI, Pt. 1, Nos. 1 and 2; Pt. 2, No. 1. The Society.
Stray Feathers, IX, 5—X, 3. I. V. Williamson Fund.
Cambridge. Appalachian Mountain Club. Appalachia, II, 4; III, 1. The Club.
Harvard University. Library Bulletin, Nos. 21, 22 and 23. Bibliographical Contributions, No. 13. The Trustees.
Museum of Comparative Zoology. Memoirs, VII, Pt. 2, Nos. 2 and 3; IX, 1. Reports, 1880–81, 1881–82. Bulletin VII, 2–6; IX, 1–8; X, 1. The Director.
Nuttall Ornithological Club. Bulletin VII, 1–4. The Club.
Psyche, Nos. 86–96. The Editor.
Canada. Royal Society of. Inaugural Meeting. The Society.
Cap Rouge. Le Naturaliste Canadien, XII, 144–148. The Editor.
Cassel. Malakozoologische Blätter, V, 1–7. I. V. Williamson Fund.
Verein für Naturkunde. Bericht XXVIII. The Society.
Catania. Accademia Gioenia di Scienze Naturali. Atti, 3a Ser., T. 13, 14, 15. The Society.
Chemnitz. Naturwissenschaftliche Gesellschaft, 7er Bericht. The Society.
Chicago. American Antiquarian, IV, 1–4. The Editor.
Chicago Field, X, 11, 19, 25; XIII, 6, 7, 9, 10, 12, 13; XIV, 2, 6, 8, 15, 19, 20; XV, 8. F. V. Hayden.
Christiania. Archiv für Mathematik og Naturvidenskab, VI, 3–5. The Editor.
K. N. Frederiks Universitet. Aarsberetning, 1878, 1879 and 1880. The University.
Norwegische Meteorologische Institut. Jahrbuch, 1877–1880. The Institute.

Nyt Magazin for Naturvidenskaberne, 24e Bd. 4 H—27e Bd. 1 H. The Editor.
Videnskab-Selskabet. Forhandlinger, 1878–1881. The Society.
Cincinnati. Ohio Mechanics' Institute. Scientific Proceedings, I, 1–3. The Institute.
The Paleontologist. No. 6. The Editor.
Society of Natural History. Journal, V, 1–4. The Society.
Zoological Society. 8th annual report. The Society.
Clausthal. Berg- und Hüttenmännischer Verein Maja. Mittheilungen, n. f. H. 2. F. V. Hayden.
Congrès Geologique Internationale. Rapports, 2me Ses. F. V. Hayden.
Copenhagen. K. D. Videnskabernes Selskab. Oversigt, 1881, Nos. 2, 3; 1882, No. 1. Skrifter, 6me Ser., I, 3, 4; II, 1. The Society.
Naturhistorisk Tidsskrift. Schiodte. XIII, 1, 2. I. V. Williamson Fund.
Videnskabelige Meddelelser, 1881, Nos. 1, 2. The Editor.
Cordoba. Academia nacional de Ciencias exactas. Actas I. The Society.
Crawfordsville. Botanical Gazette, VI, 12—VII, 11. The Editor.
Davenport. Academy of Natural Sciences. Proceedings, III, 2. The Society.
Denver. Inter-Ocean, I, 1, 4, 13. F. V. Hayden.
Dresden. K. Leop. Carol. Deutsche Academie der Wissenschaften. Nova Acta, Vol. 41, Pts. 1 and 2. Leopoldina, H 16. The Society.
K. Mineralogisch-Geologische und Præhistorische Museum. Mittheilungen, 4es H. The Director.
Naturwissenschaftliche Gesellschaft Isis, Jan.–Juli, 1882. The Society.
Dublin. Royal Dublin Society. Proceedings, n. s., II, 7—III, 4. Transactions, Ser. 2, I, 13, 14. The Society.
Royal Geological Society of Ireland. Journal, XVI, 1. The Society.
Royal Irish Academy. Proceedings; Polite Literature and Antiquities, II, Ser. 2, No. 3; Science, III, Ser. 2, Nos. 3, 7. Transactions; Science, XXVIII, 6–10. The Society.
Eastbourne. Natural History Society. Transactions, I, 1. F. V. Hayden.
Edinburgh. Botanical Society. Transactions and Proceedings, XIV, 2. The Society.
Royal Physical Society. Proceedings, 1880–81. The Society.
Royal Society. Proceedings, X, 108. Transactions, XXX, 1. The Society.
Scottish Naturalist, Nos. 45–48. The Editor.
Emden. Naturforschende Gesellschaft, 66er Jahresb. The Society.
Erfurt. K. Akademie gemeinützliger Wissenschaften. Jahrbuch, n. f., 11er H. The Society.
Erlangen. Physikalisch-medicinische Societät. Sitzungsberichte, 13er H. The Society.
Florence. R. Istituto di Studi Superiori practici e di perfezionamento. Publicazioni, Sezione di Scienze fisiche e naturali, 1877, 1878 and 1879. The Society.
Frankfurt a. M. Aerztlicher Verein. Jahresbericht, XXIV, XXV. The Society.
Deutsche Malakozoologische Gesellschaft. Jahrbücher, VIII, 4—IX, 4. Nachrichtsblatt, 1881, H. 11—1882, H. 9. The Society.
Frankfurter Verein für Geographie und Statistik. Jahrgang XLII–XLV. F. V. Hayden.
Senckenbergische Naturforschende Gesellschaft. Abhandlungen XII, 3, 4. Bericht, 1880–81.
Der Zoologische Garten, XXII, 1–12. The Zoological Society.
Freiburg i. B. Naturforschende Gesellschaft. Bericht VIII, 1. The Society.
Gand. Archives de Biologie, Van Beneden und Van Bambeke. I, 4—III, 2. I. V. Williamson Fund.
Geneva. Club Alpin. Conference Internationale, 15me Assemblée générale. F. V. Hayden.

Schweizerische paläontologische Gesellschaft. Abhandlungen VIII. I. V. Williamson Fund.
Société de Physique et de Historie Naturelle. Mémoires, XXVII, 2. The Society.
Société Suisse de topographie. Bulletin I, 1, 2; II, 1, 2. F. V. Hayden.
Genoa. Società di Letture e Conversazioni Scientifiche. Giornale, VI, 1–8. The Society.
Giessen. Jahresbericht über die Fortschritte der Chemie. Fittica, 1880, H. 2–4. The Editor.
Oberhessische Gesellschaft für Natur- und Heilkunde. 21er Bericht. The Society.
Glasgow. Geological Society. Transactions, VI, 1, 2. The Society.
Natural History Society. Proceedings, III, 3; IV, 2. The Society.
Philosophical Society. Proceedings, XIII, 1. The Society.
Görlitz. Naturforschende Gesellshaft. Abhandlungen XVII. The Society.
Göttingen. K. Gesellschaft der Wissenschaften. Nachrichten, 1881. The Society.
Graz. Verein der Ärzte in Steiermark. Mittheilungen, Vereinsjahr 1881. The Society.
Halle. Naturforschende Gesellschaft. Bericht, 1880–1881. The Society.
Verein für Erdkunde. Mittheilungen, 1881. The Society.
Harlem. Musée Teyler. Archives, 2e Ser., 2e Partie. The Director.
Société Hollandaise des Sciences. Archives, XVII, 1, 2. The Society.
Helsingfors. Finska Vetenskaps-Societeten. Öfversigt 22, 23. Bidrag 33–36. Observations Meteorologiques, 1879. Katalog der Bibliothek, 1881. The Society.
Hereford. Woolhope Naturalist's Field Club. Transactions, 1871–2–3. F. V. Hayden.
Hermannstadt. Siebenbürgische Verein für Naturwissenschaften. Verhandlungen und Mittheilungen, Jahrg. 32. The Society.
Innsbruck. Ferdinandeum. Zeitschrift, 3e Folge, 26es H. The Director.
Italy. Ministero di Agricoltura, Industria e Commercio. Annali di Agricoltura Nos. 8, 11, 25, 34.
Jena. Medicinisch-naturwissenschaftliche Gesellschaft. Zeitschrift, XV, 3, 4. Sitzungsberichte, 1881. The Society.
Kansas City. The Kansas City Review, V, 8—VI, 7. The Editor.
Klagenfurt. Kärnter Gartenbau Verein. Jahresbericht, 1879. Zeitung X, 1; XI, 1–3. F. V. Hayden.
Landesmuseum von Kärnten. Jahrbuch, XV. Bericht, 1880, 1881. Carinthia, 1880, 1881. Diagramme der magn. u. meteorol. Beobachtungen, 1876–1881. The Director.
Königsberg. Physikalisch-ökonomische Gesellschaft. Schriften, XXII, 1, 2. The Society.
Lahr. Zeitschrift für wissenschaftliche Geographie, I, 2, 3, 5, 6; II, 1, 2, 5; III, 1. F. V. Hayden.
Lausanne. Société Vaudoise des Sciences Naturelles. Bulletin, Nos. 85, 86 and 87. The Society.
Leeds. Philosophical and Literary Society. Annual report, 1881–82. The Society.
Leipzig. Archiv für Anatomie und Physiologie. Anatomische Abth., 1881, H. 6; 1882, H. 1–3. Physiologische Abth., 1881, H. 6; 1882, H. 1–4 und Suppl. I. V. Williamson Fund.
Botanischer Jahrbücher. Engler II, 4—III, 4 I. V. Williamson Fund.
Jahresberichte über die Fortschritte der Anatomie und Physiologie. Hofmann und Schwalbe. V–IX; X, 1, 2. I. V. Williamson Fund.
Jahrbücher für wissenschaftliche Botanik, XIII, 1–3. I. V. Williamson Fund.

Journal für Ornithologie, XXIX, 4—XXX, 1-3. I. V. Williamson Fund.
Morphologisches Jahrbuch, VII, 3—VIII, 2. I. V. Williamson Fund.
Naturforschende Gesellschaft. Sitzungsberichte, 1881. The Society.
Zeitschrift für Krystallographie und Mineralogie. Groth. VI, 3—VII, 3. I. V. Williamson Fund.
Zeitschrift für wissenschaftliche Zoologie, XXXVI, 3—XXXVII, 3. I. V. Williamson Fund.
Zoologischer Anzeiger. H. 97-124. The Editor.
Zoologische Station zu Neapel. Mittheilungen, I; II; III, 1-4. I. V. Williamson Fund.

Liege. Société Royale des Sciences. Mémoires, 2me ser., IX. The Society.

Lisbon. Associacão dos Engenheiros civis Portuguezes. Revista de Obras publicas e Minas. X, 143-153. The Society.

London. Annals and Magazine of Natural History, VIII, 48-59. I. V. Williamson Fund.
Astronomical Register, Nos. 228-239. I. V. Williamson Fund.
British Association for the Advancement of Science. Report, 51st meeting. I. V. Williamson Fund.
Chemical Society. Journal, Jan., 1876—Dec., 1881, twelve volumes. Nos. 230-240. The Society.
Curtis's Botanical Magazine. Nos. 1138-1149. I. V. Williamson Fund.
The Electrician. VIII, 1—IX, 26. The Editor.
Entomological Society. Transactions, 1881. The Society.
The Gardener's Chronicle. Nos. 412-463. The Editor.
Geological Magazine. Nos. 210-221. I. V. Williamson Fund.
Geological Society. Quarterly Journal, Nos. 148-151; List, 1881. The Society.
Hardwicke's Science Gossip. Nos. 204-215. I. V. Williamson Fund.
Ibis. Oct., 1881 and 4th Ser., VI, 21-24. I. V. Williamson Fund.
Journal of Anatomy and Physiology, XVI, 2—XVII, 1. I. V. Williamson Fund.
Journal of Botany, British and Foreign. Nos 228-239. I. V. Williamson Fund.
Journal of Physiology. Foster, III, 3, 6 and Suppl. 2. I. V. Williamson Fund.
Journal of Science. III, 3rd Ser, Nos. 96-107. I. V. Williamson Fund.
Knowledge. Nos. 17-52. The Editor.
Linnean Society. Journal, Botany, Nos. 108-121; Zoology, Nos. 84-94. Transactions, 2d Ser. Zoology, II, 2-5; Botany, II, 1. List, 1881. Proceedings, July, 1882. The Society.
London, Edinburgh and Dublin Philosophical Magazine. 1881, XII, 77-89. I. V. Williamson Fund.
Mineralogical Society of Great Britain and Ireland. Mineralogical Magazine and Journal of the. II, 21 and 22. I. V. Williamson Fund.
Nature. Nos. 629-681. The Editor.
Notes and Queries. 6th Ser., Pts. 23-31. The Editor.
Quarterly Journal of Microscopical Science. New Series, Nos. 85-88. I. V. Williamson Fund.
Royal Asiatic Society of Great Britain and Ireland. Journal, n. s., XIII, 4—XIV, 3. The Society.
Royal Geographical Society. Proceedings, n. s., II, 9—IV, 9. Journal, Vol. 50. The Society.
Royal Microscopical Society. Journal, Ser. 2., Vol. I, 6—II, 5. The Society.
Royal Society. Proceedings, Nos. 197-220. Philosophical Transactions, Vol. 172, No. 3; 173, No. 1. Catalogue of Library, I. The Society.
Scientific Roll, Nos. 1-9. The Editor.

Society of Arts. Journal, Vol. 29. The Society.
Society of Telegraph Engineers. Journal, IX, 33. F. V. Hayden.
Trübner's American and Oriental Literary Record. Nos. 167–176. The Publishers.
Zoological Society. Proceedings, 1881, Pt. 3—1882, Pts. 1 and 2. Index, 1871–1880. Transactions, XI, 6. Index, I–X. List of Fellows, 1882. The Society.
Zoologist. 1881, V, 60–71. I. V. Williamson Fund.
London, Ca. Canadian Entomologist, XIII, 12—XIV, 11. The Editor.
Louvain. Université Catholique. Annuaire, 6e Année. Fourteen Theses. The University.
Lübeck. Naturhistorisches Museum. Jahresbericht, 1881. The Society.
Lüneberg. Naturwissenschaftlicher Verein. Jahreshefte, VIII. The Society.
Lyon. Lyon Scientifique et Industriel, 2e Année, Nos. 2, 3, 10 and 11. F. V. Hayden.
Sociéte de Géographie. Bulletin, III, 17, 18, 19, 21. F. V. Hayden.
Madrid. Memorial de Ingenieros. An. 36, No. 22—An. 37, No. 21. The Editor.
Sociedad Geográfica. Boletin, VIII, 4–6; IX, 1–6; X, 1–5; XI, 1–6; XII, 1 and 2. F. V. Hayden.
Malden, Mass. Middlesex Institute. Annual reports, 1881–82. The Society.
Manchester. Scientific Students' Association. Annual report, 1880. The Society.
Marburg. Gesellschaft zür Beförderung der gesammten Naturwissenschaften. Sitzungsberichte, 1880, 1881. Schriften, 8vo II, 7. Schriften, 4to II, 5. The Society.
Marlborough. Marlborough College Natural History Society. Report No. 30. F. V. Hayden.
Marseille. Club Alpin Français. Section de Province. Bulletin, 1880. Nos. 1–4. F. V. Hayden.
Mexico. Ministerio de Fomento. Anales, V, VI. Boletin, 1882. The Department.
Museo Nacional. Anales, II, 5–7. The Director.
Sociedad de Geografia y Estadistica de la Republica Mexicana. Boletin, V, 4–11. The Society.
Sociedad Mexicana de Historia Natural. La Naturaleza, V, 11—VI, 3. The Society.
Milan. Fondazione Scientifica Cagnola. Atti, VI, 2. The Society.
R. Istituto Lombardo di Scienze e Lettere. Rendiconti, Ser. II, Vol. 13. The Society.
Regio Istituto technico superiore. Programma, 1881–82. The Institute.
Milwaukee. Naturhistorischer Verein von Wisconsin. Jahresbericht, 1881–82. The Society.
Mons. Société des Science, des Arts et des Lettres du Hainaut. Memoires, 4me Ser., V. The Society.
Montreal. The Canadian Naturalist, n. s., X, 3–6. The Editor.
Numismatic and Antiquarian Society. Canadian Antiquarian, X, 2; XI, 1. The Society.
Moscow. Société Impériale des Naturalistes. Bulletin, 1881, No. 1. The Society.
Munich. Gesellschaft für Anthropologie, Ethnologie und Urgeschichte. Beitrage, IV, 4; V, 1. The Society.
K. B. Akademie der Wissenschaften. Sitzungsberichte der math.-phys. Classe, 1881, Nos. 2–4; 1882, No. 1. Abhandlungen, mathem.-physikal. Classe, XIV, 1. The Society.
K. Sternwart. Beobachtungen, 1881. The Observatory.
Neuchatel. Société des Sciences Naturelles. Bulletin, XII, 2, 3. The Society.

Newcastle. North Staffordshire Naturalists' Field Club and Archæological Society. Annual report, 1881. F. V. Hayden.

New Haven. The American Journal of Science, 1881, No. 132; 1882, No. 143. The Editor.

Connecticut Academy of Arts and Sciences. Transactions, V, 2. The Academy.

Yale College. Catalogue, 1881–82. The Trustees.

New Jersey. Pharmaceutical Association. Proceedings, 1882. The Society.

New York. Academy of Sciences. Transactions, 1881–1882, I, 1–3. The Society.

American Chemical Society. Journal, III, 7 and pp. 81, et seq. The Society.

American Fish Cultural Association, 10th annual meeting. The Society.

American Geographical Society. Bulletin, 1878, No. 4; 1881, Nos. 2–5; 1882, No. 1. Journal, XI–XIII. The Society.

American Journal of Microscopy, VI, 9–12. The Editor.

American Monthly Microscopical Journal, II, 8, 9, 11, 12; III, 1–11. The Editor.

American Museum of Natural History, 13th annual report. Bulletin, Nos. 1, 2 and 3. The Director.

Appleton's Literary Bulletin, I, 1, 2. The Publishers.

Food and Health, II, 10. The Editor.

Forest and Stream, XVII, 18—XIX, 17. The Editor.

Library Journal, VI, 11—VII, 11. I. V. Williamson Fund.

Mining Record, V, 20, 21, 23–25; VI, 1–9, 11–26; VII, 1–26; VIII, 1–26; IX, 1 26; X, 1–27; XI, 1–15. F. V. Hayden.

Monthly Index to Current Periodical Literature, II, 6. The Editor.

New York Medical Eclectic, 1882, July and Aug. The Editor.

New York Medical Journal, XXXIV, 6—XXXVI, 5. The Editor.

Popular Science Monthly, 1882, Jan.-Dec. The Editor.

Science, Nos. 75–82. The Editor.

Scientific American, XL, 26; XLI; XLII, 1–18, 20, 26; XLIII; XLIV, 1–13. Supplement, Nos. 179, 182–198, 200–216, 218–226, 228–230, 232–244, 246–278, June 7, 1879—Apr. 16, 1881. F. V. Hayden.

Same. Supplement, 1882, Nos. 314–327. C. P. Perot.

Torrey Botanical Club. Bulletin, VIII, 12—IX, 12. The Society.

Nuremberg. Naturhistorische Gesellschaft. Abhandlungen, VII. The Society.

Orleans. Société d'Agriculture, Sciences, Belles-Lettres et Arts. Mémoires, 2e Ser., XXII, 1—XXIII, 2. The Society.

Paris. Annales des Mines, 7me Ser., XIX, 4—8me Ser. [illegible] Minister of Public Works, France.

Annales des Sciences Géologiques, XII, [illegible]—XIV, [illegible] The Editor.

Annales des Sciences Naturelles. Zoologie et Paléontologie, XII, [illegible]—XIV, [illegible] Botanique, [illegible] I. V. Williamson Fund.

Archives de Zoologie expérimentale et générale, [illegible] No. [illegible]—1882, No. [illegible] I. V. Williamson Fund.

Club Alpin Français. Annuaire, [illegible] Bulletin [illegible] Bulletin [illegible] F. V. Hayden.

École polytechnique. Journal, [illegible] The Director.

Institut National Agronomique. Annales [illegible] F. V. Hayden.

Journal de Conchyliologie, 3e Ser. XX, [illegible]—XXI, [illegible] The Editor.

Journal de Micrographie, [illegible] No. [illegible] No. 31. The Editor.

La [illegible] F. V. Hayden.

Muséum d'Histoire Naturelle. Nouvelles archives, 2me Ser. [illegible] The Society.

Le Naturaliste. 4me Année. Nos. 16-21. The Editor.
Revue de Géographie, Drapeyron. 3me Année, Jan.-Juin; 4me Année, 1880, Juil.—1881, Juin; Sept., 1881—Marz, 1882. F. V. Hayden.
Revue Géographique internationale. 4me Année, No. 4. F. V. Hayden.
Revue des Industries chimiques et agricoles. VI, 61. The Editor.
Revue Internationale des Sciences. 4me Année, No. 11—5me Année, No. 10. The Editor.
Revue Scientifique. T. 29me No. 21—1882, No. 20. The Editor.
Société d'Acclimatation. Bulletin, 1881. VIII, 8—IX, 8. The Society.
Société de Biologie. Compte Rendu des Séances, 7me Ser., I. The Society.
Société Botanique de France. Bulletin, XXVIII. Revue Bibliogr., A-D. Comptus Rendu, 4-6. The Society.
Société Géologique de France. Bulletin, 3me Ser., VII, 10, 11; VIII, 3, 5, 6; IX, 9; X, 1, 2. The Society.
Société Minéralogique de France. Bulletin, IV, 7—V, 7. The Society.
Société nationale d'Agriculture de France. Bulletin, 1872-1880; 1882, 1-9. Annuaire, 1882. Séance publique, 7 Aout, 1881. Mémoires, 1873 1877; T. 126. The Society.
Société nationale de topographie pratique. Bulletin, 1re An. Dec., Jan. and Feb. F. V. Hayden.
Société de Topographie. Bulletin, I, 1, 2, 4-12; II, 4; III and IV. F. V. Hayden.
Société Zoologique. Bulletin, 1881, No. 3—1882, No. 1. The Society.

Philadelphia. Academy of Natural Sciences. Proceedings, 1881, No. 1—1882, No. 2. Mineralogical and Geological Proceedings, No. 2. The Publication Committee.
Amateur Naturalist, I, 5 and 6. The Editor.
The American, weekly ed., I, 69-90; monthly ed., I, 1-6. The Editor.
American Entomological Society. Transactions, IX, 2—X, 2. The Society.
American Journal of the Medical Sciences, Jan.-Oct., 1882. The Editor.
American Journal of Pharmacy. LIII. 12—LIV, 11. The Editor.
American Naturalist, XV, 12—XVI, 11. The Editor.
American Pharmaceutical Association. Proceedings, 29th annual meeting. The Society.
American Philosophical Society. Proceedings, Nos. 109-112. The Society.
Civil Service Reform Association. 1st an. report. The Society.
College of Pharmacy, Alumni Association. 18th an. report. The Society.
The Dental Cosmos, XXIII, 12—XXIV, 11. The Editor.
Engineers' Club. Proceedings, II, 3—III, 2. List of Members. The Society.
Franklin Institute. Journal, 3d Ser., Nos 672-684. The Society.
The Gardener's Monthly, Dec., 1881—Nov., 1882. The Editor.
Historical Society of Pennsylvania. Pennsylvania Magazine, V, 1—VI, 2. The Society.
Literary Era, I, 1, 2. The Publishers.
Medical News and Abstract, No. 468. The Editor.
Mercantile Library Bulletin, I, 1. The Library Co.
Naturalists' Leisure Hour. Oct., 1881—Oct., 1882. The Editor.
North American Medical and Surgical Journal, I-XII. Executors of Dr. Robt. Bridges.
Stoddart's Review, Nos. 31-37. The Editor.
Zoological Society, 10th an. report. The Society.

Pisa. R. Accademia Valdarnese del Poggio. Memorie Valdarnesi, I-IV. Cenni Storici, 1880. The Society.
Società Toscana di Scienze Naturali. Atti, 13 Nov., 1881—Luglio 2, 1882. Memorie V, 1. The Society.

Plymouth. Plymouth Institution and Devon and Cornwall Natural History Society. Annual report and transactions, VII, 8. F. V. Hayden.
Portland. Society of Natural History, 16th meeting. H. C. Lewis.
Princeton. E. M. Museum of Geology and Archæology of the College of New Jersey. Annual report, 1882. The Director.
Riga. Naturforscher-Verein. Correspondenzblatt, 23er und 24er Jahrg. The Society.
Rochester. Society of Natural Sciences. Transactions, Nos. 1, 2. The Society.
Ward's Natural Science Bulletin, I, 2, 3, 4. The Editor.
Rome. R. Accademia dei Lincei. Atti, Serie Terza, Transunti, VI, 1–14. The Society.
Sacramento. Agassiz Institute. Proceedings, 1872, and five numbers for 1873. The Society.
St. Gallen. St. Gallische Naturwissenschaftliche Gesellschaft. Bericht, 1879–1880. The Society.
St. John. Natural History Society of New Brunswick. Bulletin, No. 1. The Society.
St. Petersburg. K. Akademie der Wissenschaften. Repertorium für Meteorologie. VII, 2. Mémoires, XXVIII, 3–9; XXIX, 1–4; XXX, 1, 2. Bulletin, XXVII, 3, 4. The Society.
Hortus Petropolitanus Acta, VII, 2. The Director.
Physikalische Central-Observatorium. Annalen, 1880, 1 and 2; 1881, 1. The Director.
Societas Entomologica Rossica. Horæ, XV. Transactions, XI. The Society.
Salem. Essex Institute. Bulletin, XIII, 10—XIV, 6. The Society.
San Diego. Society of Natural History. Charter, Constitution, etc., 1881, and July 7, 1882. The Society.
San Francisco. Mining Scientific Press, XXXVIII, 19, 24, 26; XXXIX, 1–8, 9, 10–26; XL, 1–14, 16–26; XLI, 1–26; XLII, 1–14, 16–19, 21–26; XLIII, 1–24, 26, 27; XLIV, 1–10. F. V. Hayden.
Pacific Rural Press, XVII, 19, 24–26; XVIII, 1–14, 16–26; XIX, 1–10, 14–26; XX, 1–12, 14–26; XXI, 1–26; XXII, 1, 4–27; XXIII, 1–10. F. V. Hayden.
Semur. Société des Sciences historiques et naturelles, 17e Année, 1880. The Society.
Springfield. Illinois State Museum of Natural History. Bulletin, No. 1, 1882. The Director.
Staunton. The Virginias, II, 11—III, 10. The Editor.
Stockholm. Entomologisk Tidskrift, II, 4; III, 1–3. The Editor.
K. Vetenskaps Akademiens. Öfversigt, 34–37. Lefnadsteckningar, II, 1. Handlingar, XIV, 2; XV and Atlas; XVI, XVII. Bihang, IV, 1, 2; V, 1, 2. The Society.
Stuttgart. Humboldt, I, 1. The Publishers.
Kosmos, V, 8—VI, 7. I. V. Williamson Fund.
Neues Jahrbuch für Mineralogie, Geologie und Palæontologie, 1881, II, 3; 1882, I, 1—II, 2; II, Beilage, Band 1. I. V. Williamson Fund.
Verein für vaterländische Naturkunde in Württemberg. Jahresberichte, 30er Jahrg. The Society.
Switzerland. Naturforschende Gesellschaft. Verhandlungen, 1880–81. The Society.
Sydney. Linnean Society of New South Wales. Proceedings, VI, 3, 4; VII, 1. The Society.
Royal Society of New South Wales. Journal and Proceedings, XIV. The Society.
Tasmania. Royal Society. Papers and Proceedings, 1880. The Society.
Throndhjem. K. N. Videnskabers Selskabet. Skrifter, 1880. The Society.

Tokio. University, Science Department. Memoirs, I, 8. Rev. Dr. Syle.
Turin. Academia Reale delle Scienze. Atti, XVI, 5–7; XVII, 1–7. The Society.
Cosmos, VI, 1–12. F. V. Hayden.
Regio Osservatorio della Regia Universita. Bollettino, Anni 15, 16. The Director.
Toronto. Canadian Institute. Proceedings, n. s. I, 2. The Society.
Entomological Society. Annual report, 1881. The Society.
Trieste. Societa Adriatica di Scienze Naturali. Bollettina, VII. The Society.
Upsal. Observatoire de l'Université. Bulletin météorologique, XIII. The Director.
Regia Societas Scientiarum. Nova Acta, XI. The Society.
Utrecht. Provinciaal Utrechtsch Genootschap von Kunsten en Wetenschappen. Verslag, 1881. Aanteekeningen, 1880–1881. The Society.
K. nederlandsch meteorologisch Instituut. Jahrboek, 1881. The Director.
Venice. R. Instituto Veneto di Scienze, Lettre et Arti. Atti, serie 5a, VI, 10, VII, 1–9. The Society.
Vienna. Anthropologische Gesellschaft. Mittheilungen, XI, 1, 3, 4; XII, 1, 2. The Society.
Embryologische Institute der K. K. Universität in Wien. Mittheilungen, II, 2. I. V. Williamson Fund.
K. Akademie der Wissenschaften. Sitzungsberichte, mathemat.-naturw. Classe 83 Bd., 1e Abth., V—85 Bd., 2e Abth., II. Denkschriften, mathem.-naturw. Classe, 43 and 44 Bd. The Society.
K. K. geologische Reichsanstalt. Jahrbuch, 1881, Nos. 2–4; 1882, Nos. 1–3. Verhandlungen, 1881, Nos. 8–18; 1882, Nos. 1–8. The Society.
K. K. zoologisch-botanische Gesellschaft. Verhandlungen, XXXI. The Society.
Verein zur Verbreitung naturwissenschaftlicher Kenntnisse. Schriften, 22er Bd. The Society.
Wiener Entomologische Zeitung. I, 1. The Editor.
Wiener Illustrirte Garten-Zeitung, 1881, No. 6—1882, No. 9. The Editor.
Zoologische Institut. Arbeiten, IV, 1, 2. The Society.
Washington. United States Fish Commission. Bulletin, 1881, pp. 1, et seq.; 1882, 1–160. The Commission.
United States National Museum. Proceedings, 1881, p. 209, et seq.; 1882, pp. 1–448. Bulletin No. 11 and No. 19. Circulars 13–17. The Director.
Wellington. New Zealand Institute. Transactions, XIV. The Society.
West Chester. Philosophical Society. Historical Sketch, Sept. 22, 1881. The Society.
Westeräs. Redogörelse för Högre Allmanna Läroverket i Westeras, 1861–1880. Westeräs Gymnasium.
Worcester. American Antiquarian Society. Proceedings, n. s. I, 1—II, 1. The Society.
Würzburg. Botanisches Institut. Arbeiten, II, 4. I. V. Williamson Fund.
Physikalisch-medicinische Gesellschaft. Verhandlungen, n. f. XVI. Sitzungsberichte, 1881. The Society.
York. Natural History Journal (and School Reporter), III, 7, 9; IV, 28–38; V, 40; VI, 46, 47. F. V. Hayden.

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